

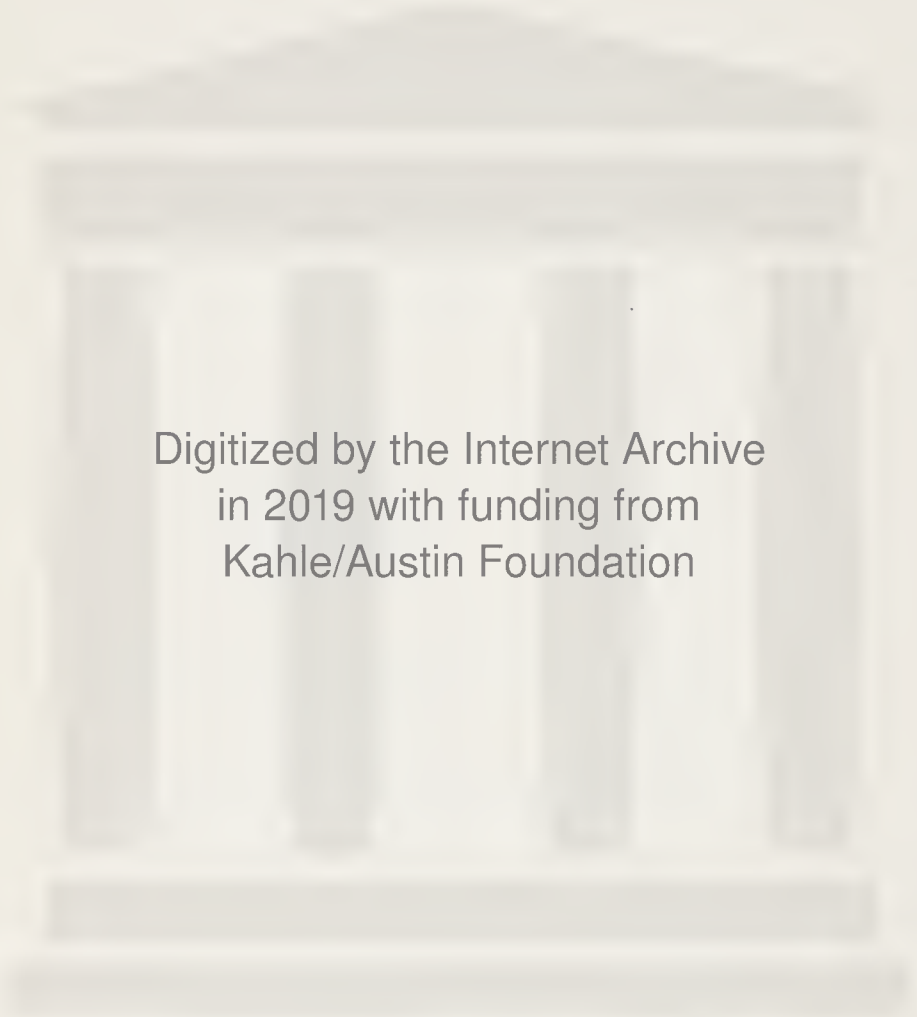


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# ASTRONOMY IN THE POETS

BY  
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O ! learned indeed were that Astronomer  
That knew the stars as I his characters ;  
He'd lay the future open.

CYMBELINE. *Act 3. Scene 2.*

But when he performs,  
Astronomers foretell it ;  
It is prodigious, there will come some  
change,  
The sun borrows of the moon  
When Diomed keeps his word.

TROILUS AND CRESSIDA. *Act 5. Scene 1.*



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## FOREWORD.

William Shakespeare, who is universally regarded as the supreme genius of our nation, has left us the richest legacy in all literature in his works which have revolutionised the poetic and dramatic thought of the world.

His works are the great glory of English literature and the pride of the British race, while they form the most magnificent, the most permanent and most enduring monument of poetic and dramatic genius that has ever been created by the human mind.

In the year 1623 the first Shakespeare Folio was published, and never in the world's history has so great a treasure of poetic and dramatic wealth appeared within the compass of a single volume. Shakespeare occupies the front rank among the great English writers who have expressed the facts of Science in poetic form, for the vast scope and wide range of his genius includes a great number of references to Astronomy, and in his verse he has adorned them with the magic beauty of his poetic imagery.

Shakespeare never depended on the stage carpenter or scene painter, he put scenery into his lines which contain an unprecedented wealth

of thought and beauty of language, and which form a rich mine of intellectual treasure, showing him to be the most universal minded genius that ever lived.

He delineates the scenery of the heavens and over all is, "The firmament fretted with golden fire," (*Hamlet*) and he describes how the "Floor of heaven is thick inlaid with patines of bright gold." (*Merchant of Venice*).

As no other poet has so many unique and beautiful astronomical references the author believed that if these could be collected together and classified for comparison and quotation, it would lead to a better understanding of the subject of Astronomy in Shakespeare.

This has been done here, and modern Astronomy has been contrasted with the Astrology of olden times, showing the ideas of "Planetary influence" and other curious Astrological ideas which obtained in Shakespeare's day.

Astronomy in Shakespeare has not received all the attention that the subject deserves, and I believe that this is the first attempt to deal in a comprehensive way with the Astronomical references to be found in the poet's works.

It may be noted here that the internal evidence of the subject of Shakespeare's treatment of Astronomy is a remarkable proof of the wide difference between the works of Shakespeare and Bacon.

Bacon sought to explain the causes of phenomena while Shakespeare was content to describe their beauty.

Bacon's works show his scientific mind, using the crucible and test tube for his experiments, while Shakespeare merely uses the Scenery of Nature to elaborate his verse and beautify his language.

It is, therefore, incredible that a man with the dry, legal and scientific mind of Bacon could have also written all the poetry, romance and beauty of Nature found in Shakespeare's works.

We know that Bacon never admitted the truth of the Copernican system, and his works are devoid of the wide Astronomical range found in Shakespeare.





## ASTRONOMY IN SHAKESPEARE.

---

Special interest attaches to the Astronomy of Shakespeare from the fact that the poet lived and wrote just at the period of the change from the ancient to the modern system of Astronomy. The ancient or Ptolemaic system derived its name from Ptolemy of Alexandria (who flourished about A.D. 100), and was called after him the Ptolemaic system.

This system taught that the earth was stationary, occupying the centre of the Universe, and that round it moved, in their several orbits, eight crystal spheres, in which were fixed, 1. the Moon; 2, Mercury; 3, Venus; 4, The Sun; 5, Mars; 6, Jupiter; 7, Saturn; 8, The Fixed Stars. There was a 9th sphere called "The Primum Mobile" (Latin, first cause of motion) which was to give motion to all the others. All the spheres revolved round the earth in 24 hours, at different distances and with varying velocities.\*

In spite of its fallacies and many palpable errors this system maintained its ground for 1500 years, until it was upset in the 16th century by the great Polish Astronomer, Nicolas Copernicus,

\* A fairly adequate description of the Ptolemaic system is to be found in Marlowe's *Doctor Faustus* (lines 644-678).

who is rightly regarded as the father of modern astronomy, and upon whose foundations all subsequent astronomers have built.

Copernicus revived the system believed to have been taught by Pythagoras about B.C. 500, but which had been relinquished on account of its apparent difficulties.

The modern or Copernican System took its name from its author Copernicus, who taught that the Sun is fixed in the centre of the system, and that the Earth and other planets revolve around it at different distances, in different periods of time, and with different velocities; that the Moon revolving round the Earth accompanies it in its annual course round the Sun; and that the apparent motion of the heavenly bodies from east to west is caused by the Earth's motion on its axis from west to east.

\*Copernicus put forth his great work in 1543, but it lay dormant for some fifty years, when Galileo, Kepler, Giordano Bruno, and others, adopted and propagated the new doctrine.

These doctrines were said to be contrary to the teaching of the Bible, of the Church, and of Aristotle. It was therefore natural that a long time should elapse before they could be safely taught, still longer before they could be generally accepted.

Even after the time of Copernicus his successor the Italian Galileo, in the seventeenth

\* COPERNICUS (Nicolau-), *De Revolutionibus Orbium coelestium*. This great work of Copernicus is the foundation of modern astronomy.

century, was put in prison and only escaped the Inquisition by abjuring his real opinions, and he was forced to state in public that he believed the earth to be stationary.

For centuries mankind was content to believe that the sun went round the earth. When Copernicus concluded that this theory no longer explained the facts, and asserted that the earth really went round the sun, he was greeted with a storm of indignant incredulity. But this theory holds the field to-day.

The truth of this system has been completely verified by the discoveries of Galileo, Kepler and Newton, who established the great laws which regulate planetary motion. Since the time of Galileo, several additional planets have been discovered, as well as satellites or moons revolving round their primaries.

Galileo was born in 1564 in the same year as Shakespeare.

Galileo read the open volume of the sky while Shakespeare described its beauties to enrich his verse; they were both astronomers, the one practical, and the other poetical.

In this connection it is a curious and interesting fact that in "Paradise Lost" written far on in this same Century, (about 1660) we see the great poet Milton, when he deals with Astronomy, obviously "sitting on the fence" in doubt as to which system to adopt. (see P.L. Book 4).

Shakespeare's plays having been written some fifty years before "Paradise Lost" it is not to be expected that any reference should be found in them to the Copernican system of Astronomy. Nor is any such reference to be found. There is nothing to show that he had any knowledge of the system, much less that he adopted it, although Robert Recorde in his book "The Castle of Knowledge" which was published in 1556 had called attention to the Copernican theory at the same time as he described the Ptolemaic system, and other writers such as John Field (1557), John Dee (1557), and Thomas Digges (1571) had written about it.

### FIRMAMENT.

The word firmament means the sky or the heavens and in ancient astronomy the firmament was the eighth sphere containing the fixed stars surrounding the seven spheres of the planets, and was sometimes described in poetry as the "Vault of Heaven."

The word "firmamentum" comes from "firmare" to make firm or strong and means a strengthening or support, and was used in this sense in the Latin Vulgate of the fourth Century.

In the Hebrew Bible the word "Rakiya" literally means "Expanse" and there is no other word in the Hebrew language which so

clearly and accurately describes the heavens as an expanse or extended arch of the sky ; the verb from which it is derived meaning “ to beat out. ’, It conveys the idea of something beaten out, spread or extended into a great expansion or enlargement. The Latin word “ firmamentum ” is of course misleading, as the heavens are neither fixed, firm, nor solid, as this word implies ; but in reality they are moving continually, floating in space, and expanding, and travelling according to the laws of motion, and the original Hebrew word meaning Expanse as used in Genesis is astronomically correct to-day.

HAMLET. *Act 2. Scene 2.*

This brave o’er hanging firmament, this  
majestical roof  
Fretted with golden fire.

RICHARD II. *Act 2. Scene 4.*

I see thy glory like a shooting star  
Fall to the base earth from the firmament.

TITUS ANDRONICUS. *Act 5. Scene 3.*

What hath the firmament more suns than  
one ?  
What boots it thee to call thyself a Sun ?

KING LEAR. *Act 3. Scene 2.*

The maidenliest star in the firmament.

WINTER’S TALE. *Act 3. Scene 3.*

— betwixt the firmament and it you  
Cannot thrust a bodkin’s point.

## SUN.

The sun is the centre of light, heat and attraction to the whole system, and round it the planets revolve.

Its diameter is 867,000 miles, and its bulk is more than 1,300,000 times greater than that of the earth. When viewed with a telescope, various spots are seen on its surface by the motion of which it is ascertained that it revolves on its axis in about 25 days and 8 hours. Its distance from the earth is nearly 93 million miles.

Shakespeare delights to describe the warmth and light of the sun. The gracious light, the supreme fair, the life of purity, are some of the terms with which he describes the beauteous eye of Heaven.

KING JOHN. *Act 4. Scene 2.*

He further describes the sun as all cheering, blushing, golden, beneficial, celestial, blessed, worshipped, gorgeous. To Shakespeare the sun seems to represent the spirit of good in the world, as opposed to night, which is symbolical of evil.

ANTONY AND CLEOPATRA. *Act 4. Scene 13.*

O thou sun !  
Burn the great sphere thou mov'st in !  
Darkling stand  
The varying shore of the world !



TIMON OF ATHENS. *Act 3. Scene 4.*

You must consider that a prodigal course  
Is like the sun's, but not, like his, recover-  
able.

TAMING OF THE SHREW. *Act 4. Scene 3.*

And as the sun breaks through the darkest  
clouds,  
So honour peereth in the meanest habit.

TIMON OF ATHENS. *Act 3. Scene 1.*

O blessed breeding sun, draw from the earth  
Rotten humidity, below thy sister's orb  
Infect the air.

I HENRY IV. *Act 1. Scene 2.*

Yet herein will I imitate the sun,  
Who doth permit the base contagious  
clouds  
To smother up its beauty from the world,  
That when he please again to be himself,  
Being wanted, he may be more wondered  
at,  
By breaking through the foul and ugly  
mists  
Of vapours that did seem to strangle him.

PERICLES. *Act 2. Scene 3.*

Yon King's to me like to my father's  
picture  
Which tells me in that glory once he was ;  
Had princes sit, like stars, about his throne,  
And he the sun for them to reverence.

In the mournful reconciliation between the rival houses after the death of Romeo and Juliet, the Prince remarks,

A glooming peace this morning with it brings,

The sun for sorrow will not show his head.

### SUNRISE AND MORNING.

What a vast wealth of beautiful imagery and metaphor the poet is inspired to express in relation to Sunrise and the Morning. I find more references under this head than any other.

The French Astronomer Flammarion, speaks of the Sun as the mighty source from which proceed all the forces which set in motion the earth and all the life on it. It is its heat which causes the wind to blow, the clouds to ascend, which causes the flowing of the river and the growth of the forest ; which causes fruit to ripen, and man himself to live. The wine which sparkles in the crystal cup has its source in rays of the sun stored up for our taste. The most nutritious foods come from the sun. The steam-engine, though produced by human industry, is still a child of the sun ; the coal that feeds it is solar work stored up during millions of years in the strata of the earth. Thunder and lightning are a manifestation of his power. Every fire which



burns and every flame which shines have received their life from the sun.

No wonder that in many countries both in ancient and modern times some nations worship the Sun as a God.

HAMLET. *Act 1. Scene 1.*

But look, the morn, in russet mantle clad,  
Walks o'er the dew of yon high eastern hill.

ROMEO AND JULIET. *Act 1. Scene 1.*

Madam, an hour before the worshipped sun  
Peer'd forth the golden window of the east,  
A troubled mind drave me to walk abroad.

VENUS AND ADONIS.

The gentle lark . . . . .  
Wakes the morning, from whose silver  
breast  
The sun ariseth in his majesty ;  
Who doth the world so gloriously behold,  
That cedar tops and hills seem burnished  
gold.

Shakespeare tells the time by appealing to the great clock of the firmament, and this method of marking the time was perfectly natural in an age when everybody did not carry "a dial in his poke" as we do now, and surely it is a more poetical way of marking the flight of time !

ROMEO AND JULIET. *Act 3. Scene 5.*

*Juliet* . . . . .

Wilt thou be gone ? it is not yet near day.

It was the nightingale and not the lark  
That pierced the fearful hollow of thine  
ear ;

Nightly she sings on yon pomegranate tree,  
Believe me, love, it was the nightingale.

*Romeo . . . . .*

It was the lark, the herald of the morn.  
No Nightingale ; look love, what envious  
streaks

Do lace the severing clouds in yonder east :  
Night's candles are burnt out, and jocund  
day

Stands tiptoe on the misty mountain tops.

SONNET 7.

Lo ! in the orient when the gracious light  
Lifts up its burning head, each under eye  
Doth homage to his new appearing sight,  
Serving with looks his sacred majesty.

KING RICHARD II. *Act 3. Scene 2.*

But when, from under this terrestrial ball,  
He fires the proud tops of the eastern pines.

MIDSUMMER NIGHT'S DREAM. *Act 3. Scene 2.*

Even till the eastern gate, all fiery-red,  
Opening on Neptune with fair blessed beams  
Turns into yellow gold his salt-green  
streams.

SONNET 132.

And truly not the morning sun of heaven  
Better becomes the gray cheeks of the east,

Nor that full star that ushers in the even  
Doth half that glory to the sober west  
As those two mourning eyes become thy  
face.

3 HENRY VI. *Act 2. Scene 1.*

See how the morning opes her golden gates,  
And takes her farewell of the glorious sun.  
And here are some references in which  
metaphor and simile are included.

ROMEO AND JULIET. *Act 2. Scene 1.*

But soft, what light through yonder window  
breaks !

It is the east, and Juliet is the sun !

ROMEO AND JULIET. *Act 2. Scene 3.*

The grey-ey'd morn smiles on the frowning  
night.

Checkering the eastern clouds with streaks  
of light.

And flecked darkness like a drunkard reels  
From forth day's pathway, made by Titan's  
wheels.

KING RICHARD II. *Act 3. Scene 3.*

See, see, King Richard doth himself appear,  
As doth the blushing discontented sun  
From out the fiery portal of the east.

When he perceives the envious clouds are  
bent

To dim his glory, and to stain the track  
Of his bright passage to the occident.

TEMPEST. *Act 5. Scene 1.*

And as the morning steals upon the night,  
Melting the darkness, so their rising senses  
Begin to chase the ignorant fumes that  
    mantle  
Their clearer reason.

VENUS AND ADONIS.

Like the fair sun, when in his fresh array  
He cheers the morn and all the earth re-  
    lieveth  
And as the bright sun glorifies the sky,  
So is her face illumined with her eye.

ANTONY AND CLEOPATRA. *Act 5. Scene 2.*

His face was as the heavens ; and therein  
    stuck  
A sun and moon, which kept their course  
    and the little O.  
The earth.

TIMON OF ATHENS. *Act 4. Scene 3.*

The sun's a thief and with his great attrac-  
    tion  
Robs the vast sea ; the moon's an arrant  
    thief,  
And her pale fire she snatches from the sun.

AURORA.

Two mythological references may here be noticed. One is Aurora, the Roman goddess of the dawn. She is represented by Homer as rising

every morning from her couch and drawn out from the east in a chariot to carry light to gods and men.

Guido Reni, a painter of genius, celebrated this in his world-famous picture which can be seen in Rome.

MIDSUMMER NIGHT'S DREAM. *Act 3. Scene 2.*

“ And yonder shines Aurora's harbinger.”

ROMEO AND JULIET. *Act 1. Scene 1.*

But all so soon as the all cheering sun  
Should in the furthest east begin to draw  
The shady curtains from Aurora's bed,  
Away from light steals home my heavy son.

### PHŒBUS' CHARIOT OR CAR.

The ancients represented the rise and progress of the Sun in the sky as Phœbus or Helios drawn by horses in a chariot. The poet is very liberal in his references to this.

ROMEO AND JULIET. *Act 3. Scene 2.*

Gallop apace, you fiery-footed steeds,  
Towards Phœbus' mansion ; such a  
waggoner  
As Phæton would whip you to the west,  
And bring in cloudy night immediately.

TITUS ANDRONICUS. *Act 5. Scene 2.*

Even from Hyperion's rising in the east,  
Until his very downfall in the sea.

TEMPEST. *Act 4. Scene 1.*

When I shall think, or Phœbus' steeds  
. are foundered  
Or Night kept chain'd below.

CYMBELINE. *Act 2. Scene 3.*

Hark, hark, the lark at Heaven's gate sings,  
And Phœbus' gins arise,  
His steeds to water at those springs  
On chalic'd flowers that lies.

HENRY IV. *Act 3. Scene 1.*

The hour before the heavenly harnessed  
team  
Begins his golden progress in the East.

3 HENRY VI. *Act 4. Scene 7.*

And when the morning sun shall raise his car  
Above the border of this horizon,  
We'll forward towards Warwick.

MUCH ADO ABOUT NOTHING. *Act 5. Scene 3.*

And, look, the gentle day  
Before the steeds of Phœbus' round about  
Dapples the drowsy east with spots of grey.

KING LEAR. *Act 2. Scene 2.*

Under the allowance of your grand aspect,  
Whose influence, like the wreath of radiant  
fire  
On flickering Phœbus' front.

ANTONY AND CLEOPATRA. *Act 4. Scene 8.*

He has deserved it, were it carbuncled  
Like holy Phœbus car.

HAMLET. *Act 3. Scene 2.*

Full thirty times hath Phœbus' car gone  
round

Neptune's salt wash, and Tellus' orb'd  
ground.

ALL'S WELL THAT ENDS WELL. *Act 2. Scene 1.*

Ere twice the horses of the sun shall bring  
Their fiery torcher his diurnal ring.

SONNET. 7.

But when from highest pitch, with weary  
car,

Like feeble age, he reeleth from the day.

I HENRY IV. *Act 1. Scene 2.*

We that take purses, go by the moon and  
seven stars

And not by Phœbus.

The seven stars here refer to the Pleiades  
which have been familiar as household words from  
the earliest times.

## NIGHT, SUNSET, NIGHT SKY.

We often hear it stated as a fact that certain  
things could never be known or even exist apart  
from their opposites ; for example, that good could  
not exist without evil, pleasure without pain,  
harmony without discord, light without darkness.  
Whether this is so or not, this at least seems  
certain, that if there were no night, we should never



have known the wonders revealed by the starry heavens.

This thought is nowhere more beautifully expressed than in Blanco White's sonnet, "Night and Death."

Mysterious Night ! when our first parent  
knew

Thee from divine report, and heard thy  
name,

Did he not tremble for this lovely frame,  
This glorious canopy of light and blue ?

Yet 'neath a curtain of translucent dew,  
Bathed in the rays of the great setting flame,

Hesperus with the host of heaven came,  
And lo ! creation widened in man's view,

Who could have thought such darkness lay  
concealed

Within thy beams, O Sun ! or who could  
find,

Whilst fly and leaf and insect stood re-  
vealed

That to such countless orbs thou mad'st  
us blind.

Why do we then shun Death with anxious  
strife ?

If Light can thus deceive, wherefore not  
Life ?

The beauty the calm, the magical influence,  
the restorative power of the night are felt in some  
degree by all, and beautiful passages without



number in our literature attest what a source of inspiration the night and the starry heavens have been. The great philosopher Kant said, "Two things strike me dumb ; the starry heavens above and the moral law within." But perhaps of all the feelings evoked by the night and the stars especially to those doomed to endure the rush and turmoil of the great city the chief is that of *calm*. Goethe has the fine saying, " Like a star, without haste, yet without rest, let each one revolve round his own task." Emerson says, " If a man would be alone, let him look at the stars." And then how refreshing is the *stillness* of the night, what Milton beautifully calls " the soft silence of the list'ning night."

Shakespeare appears, for dramatic purposes, to have a positive dislike for the night. Black-browed, pitchy, long, tedious, ugly, endless, melancholy, hateful, dark eyed, hell black, comfort killing, dark dismal-dreaming, horrid night, the child of hell, are some of the epithets applied.

ROMEO AND JULIET. *Act 1. Scene 2.*

At my poor house, look to behold this night  
Earth-treading stars, that make dark  
heaven light.

ROMEO AND JULIET. *Act 2. Scene 2.*

Two of the fairest stars in all the heaven,  
Having some business, do entreat her eyes  
To twinkle in their spheres till they return.

What if her eyes were there, they in her head?  
The brightness of her cheek would shame  
those stars,  
As daylight does a lamp ; her eye in heaven  
Would through the airy region stream so  
bright  
That birds would sing, and think it were  
not night.

KING RICHARD II. *Act 2. Scene 4.*

The sun sets weeping in the lowly west,  
Witnessing storms to come, woe, and unrest.

ROMEO AND JULIET. *Act 3. Scene 2.*

Spread thy close curtain, and come civil  
night,

Thou sober-suited matron, all in black ;

. . . . .

Come, gentle night ; come, loving black  
browed night.

THE RAPE OF LUCRECE.

Till sable night, mother of Dread and Fear,  
Upon the world dim darkness doth display,  
And in her vaulty prison stows the day.

ALL'S WELL THAT ENDS WELL. *Act 2. Scene 1.*

Ere twice in murk and occidental damp  
Moist Hesperus hath quenched his sleepy  
lamp.

JULIUS CÆSAR. *Act 3. Scene 1.*

The skies are painted with unnumber'd  
sparks

They are all fire and every one doth shine.

In *MACBETH* the gloom of night is intensified by the frequent allusions to the darkness around.

*MACBETH. Act 1. Scene 5.*

Come thick night

And pall thee in the dunnest smoke of hell.

*MACBETH. Act 2. Scene 4.*

By the clock, 'tis day,

And yet dark night strangles the travelling lamp ;

I'st night's predominance, or the day's shame

That darkness does the face of earth entomb  
When living light should kiss ?

*MACBETH. Act 3. Scene 2.*

Come, seeling night,

Skarf up the tender eye of pitiful day.

Good things of day begin to droop and drowse,

Whiles night's black agents to their prey do rouse.

### MOON, MOONLIGHT.

The Moon has a special interest for us. It is our nearest neighbour of all the heavenly bodies, only 240,000 miles distant ; our beautiful companion, most probably our child. As the life and spirit of some beautiful child haunts the home to which it belongs and graces it with varied

charms, so this child of the earth wanders round about us, periodically charming us with its beauty and giving light to our darkness. The planets are very differently favoured as regards moons. We have one ; Venus and Mercury have none ; Mars has two ; Jupiter has nine ; Saturn has ten ; Uranus has four ; Neptune has one.

The soft and silvery beams of moonlight have kindled poetic and romantic sentiments in the breasts of mortals from time immemorial. The realm of poetry abounds in beautiful passages hereon. And nowhere are they more beautiful than in Shakespeare.

The moon has been an object round which a great variety of superstitions have gathered, and many survive to the present day. In Shakespeare we have several illustrations of this. "The man in the moon" \*(*Mids. N.D. v. 1, 251*) is an example of the many popular delusions. In olden times it was thought to be propitious to do certain things when the moon was in particular constellations. Again, the waxing and waning of the moon were supposed to affect for good or ill various operations. It has been a very common belief that the moon has a harmful influence on human beings and on terrestrial things generally. Many words in our language point to this curious belief ; for example "lunatic," "moony," "moon-struck," "moon-blind," "moon-calf." There are various superstitions connected with the new

moon. Perhaps the most common and widespread of lunar superstitions is the belief that the varying changes of the moon influence the weather. Another asserts that the position of the crescent moon (for instance, "lying on her back") affects the weather. Another is contained in the old saying, "the moon eats up the clouds." These superstitions are strange and interesting, but modern science pronounces every one of them to be absolutely without any foundation.

The Moon completes her revolution round the Earth, that is, she returns to the same place among the stars, in 27 days and  $7\frac{1}{2}$  hours ; but the period which elapses between one new moon and another, is 29 days  $12\frac{1}{2}$  hours ; because whilst the moon is making a revolution round the earth, the earth itself will have moved on in its course round the sun ; so that for the moon to arrive again at the conjunction, will require two more days. During her revolution, she presents to us a constant change in her appearance, which is familiar to all.

The cause of the different Phases of the Moon, as they are called, is thus explained. The Planets and their Moons do not shine by their own light, but by a reflected light, from the Sun ; therefore when the Moon is between the Earth and the Sun, at her conjunction, her illuminated side is wholly turned away from the Earth, and she is not visible, in about two days she begins to appear,

a small part of her enlightened face being seen from the Earth.

This is what is termed the New Moon. As she proceeds in her revolution, more and more of her is seen ; and when she has passed through a quarter of her orbit, half of her illuminated side is visible from the Earth.

When she arrives on the other side of the Earth, or at the opposition, it is plain that the whole of her enlightened side is seen ; she is then said to be full.

She then begins to diminish until she arrives at the conjunction, when she is totally obscured. The Moon always keeps the same side turned towards the Earth ; this means that she makes one revolution on her axis during her revolution round the earth.

The physical constitution of the Moon is better known to us than that of any other heavenly body. By the aid of telescopes we discern inequalities in her surface, which can be no other than mountains and valleys.

Wolves and dogs were said to howl when the moon shines brightly. Brutus says in JULIUS

*CÆSAR, Act 4, Scene 3.*

I'd rather be a dog, and bay the moon,  
Than such a Roman.

In poetry a function of the moon was to befriend lovers in their stolen interviews.



ROMEO AND JULIET. *Act 9. Scene 2.*

*Romeo.*

Lady, by yonder blessed moon I swear,  
That tips with silver all these fruit-tree  
tops.

*Juliet.*

O, swear not by the moon, the inconstant  
moon,  
That monthly changes in her circled orb,  
Lest that thy love prove likewise variable.

ANTONY AND CLEOPATRA. *Act 5. Scene 2.*

Now from head to foot  
I am marble-constant ; now the fleeting  
moon  
No planet is of mine.

TAMING OF THE SHREW. *Act 4. Scene 5.*

And the moon changes even as your mind.

LOVE'S LABOUR'S LOST. *Act 5. Scene 2.*

Thus change I like the moon.

TIMON OF ATHENS. *Act 4. Scene 3.*

*Alcibiades.*

How came the noble Timon to this change ?

*Timon.*

As the Moon does, by wanting light to give ;  
But then renew, I could not, like the moon :  
There were no suns to borrow of.

KING LEAR. *Act 2. Scene 1.*

Mumbling of wicked charms, conjuring the  
moon  
To stand his auspicious mistress.

HENRY V. *Act 5. Scene 2.*

But a good heart Kate is the sun and moon ;  
or, rather, the sun and not the moon ;  
for it shines bright and never changes, but  
keeps his course truly.

AS YOU LIKE IT. *Act 3. Scene 2.*

And thou thrice crowned queen of night  
survey  
With thy chaste eye, from thy pale sphere  
above,  
Thy Huntress' name, that my full life doth  
sway.

The Moon was supposed to have a dangerous  
power over the brain as Othello says.

OTHELLO. *Act 5. Scene 2.*

It is the very error of the moon ;  
She comes too near the earth than she was  
wont ;  
And makes men mad.

ANTONY AND CLEOPATRA. *Act 4. Scene 9.*

O sovereign mistress of true melancholy,  
The poisonous damp of night disponge  
upon me ;  
That life, a very rebel to my will,  
May hang no longer on me.

MACBETH. *Act 3. Scene 5.*

Upon the corner of the moon  
There hangs a vapourous drop profound ;  
I'll catch it ere it come to ground ;



And that distill'd by magic slights,  
Shall raise such artificial sprights, etc.

MIDSUMMER NIGHT'S DREAM. *Act 2. Scene 2.*

Therefore the moon, the governess of floods  
Pale in her anger, washes all the air,  
That rheumatic diseases do abound.

KING JOHN. *Act 4. Scene 2.*

*Hubert.*

My Lord, they say, five moons were seen  
to-night

Four fixed ; and the fifth did whirl about  
The other four, in wondrous motion.

*King John.*

Five moons ?

*Hubert.*

Old men and beldames, in the streets  
Do prophesy upon it dangerously.

ANTONY AND CLEOPATRA. *Act 4. Scene 10.*

Let me lodge Lichas on the horns o' the  
moon.

2 HENRY IV. *Act 4. Scene 3.*

*Falstaff to Prince John.*

And I, in the clear sky of fame, o'ershine  
you as much as the full moon doth the  
cinders of the element, which show like  
pins' heads to her.

The following is Shakespeare's reference to  
the man in the Moon ; in the conversation between  
Caliban and Stephano.

THE TEMPEST. *Act 2. Scene 2.*

*Caliban.*

Hast thou not dropped from heaven ?

*Stephano.*

Out o' the moon I do assure thee : I was  
the man i' th' moon, when time was.

*Caliban.*

I have seen thee in her, and I do adore  
thee : my mistress show'd me thee, and  
thy dog and thy bush.

VENUS AND ADONIS.

But hers, which through the crystal tears  
gave light

Shone like the moon in water seen by night.

MERCHANT OF VENICE. *Act 5. Scene 1.*

How sweet the moonlight sleeps upon this  
bank !

*(Quoted elsewhere).*

The moon was supposed to be subject to  
witches. *Prospero* declared that *Sycorax*

“ was a witch and one so strong

That could control the moon, make flows  
and ebbs,

And deal in her command, without her  
power.”

TEMPEST. *Act 5. Scene 1*

In Shakespeare the moon has many names  
bestowed upon her—“ like to a silver bow new  
bent in heaven, governess of floods, goddess of the

night, thrice crowned queen of night, Phœbe, Dictynna, Luna, Cynthia, Diana, the watery star, the sov'reign mistress of true melancholy, etc."

## ECLIPSES.

In ancient times eclipses were universally regarded with wonder and alarm. And we cannot be surprised at this; for imagine how alarming it must have been, before the true causes of eclipses were known, to observe, on a fine clear day, the great fount of light and life being gradually, as it were, eaten away, and sometimes actually extinguished, before the observer's eyes. As ghosts flee before the rising beams of the sun, so ignorance, fear, and superstition pale and vanish before the advance of knowledge. We now know precisely how eclipses occur and their advent causes no fear.

An eclipse of the sun is caused by the moon coming between the earth and the sun and cutting off the whole or part of the sun's light. An eclipse of the moon is caused by the earth coming between the sun and the moon and cutting off the whole or a part of the moon's light. In an eclipse of the Sun the moon's shadow, directed to the earth, is in the form of a cone. The point of the cone runs over a narrow belt of the earth, never exceeding 170 miles in width. All the inhabitants of the earth who are within this belt

witness a total eclipse. Those within 1,000 to 2,000 miles on either side will see a larger or smaller part of the sun concealed by the body of the moon. An eclipse of the Sun can only happen at new moon, and an eclipse of the Moon at full moon.

Shakespeare has many references to the superstitions of the time concerning eclipses.

KING LEAR. *Act 1. Scene 2.*

*Gloster.*

These late eclipses in the Sun and Moon  
portend no good to us . . . love  
cools, friendship falls off, brothers divide ;  
in cities, mutinies ; in countries, discord ;  
in palaces, treason ; and the bond cracked  
'twixt son and father.

OTHELLO. *Act 5. Scene 2.*

O ! insupportable ! O ! heavy hour !  
Methinks it should be now a huge eclipse  
Of sun and moon ; and that the affrighted  
globe  
Should yawn at alteration.

ANTONY AND CLEOPATRA. *Act 3. Scene 11.*

Alack, our terrene moon  
Is now eclips'd ; and it portends alone  
The fall of Antony.

SONNET 35.

Clouds and eclipses stain both moon and  
sun.

An eclipse was also considered to be a favourable time for casting spells, for among the ingredients of the witches' cauldron were

“Slips of yew  
Silvered in the moon's eclipse.”

MACBETH. *Act 4. Scene 1*

SONNET 107.

The mortal moon hath her eclipse endured.

### ASTROLOGY.

Astrology was the so-called “science” of foretelling the fate of nations or individuals from indications given by the positions of the Sun, Moon, and planets. The belief in a connection between these heavenly bodies and the life of man has always played an important part in human history.

For long ages Astronomy and Astrology went hand in hand, the separation was effected by the advent of modern Astronomy at the beginning of the 17th Century.

Formerly a distinction was made between “Natural Astrology” which predicts the motions of the heavenly bodies, eclipses, etc., and “Judicial Astrology” which studies the influence of the stars on human destiny. In ancient Babylonian days, 3,000 years before Christ, the Priests studied the face of the heavens and claimed the

power of foretelling the future as a result of their observations of the Sun, Moon, and Stars, their relative position to one another and peculiarities noted at any point in the course of their movements. In the case of the Moon for instance, the exact appearance of the new crescent, its position in the heavens, the conditions at conjunction and opposition, the appearance of the horns, the halo frequently seen round a new moon, the ring round the full moon ; to all these phenomena some significance was attached and this was naturally intensified in the case of such a striking phenomenon as an Eclipse of the Moon.

Of the planets five were recognised, Jupiter, Venus, Saturn, Mercury, and Mars, and these were identified with the great heathen deities whose names they bore. The movements of the Sun, Moon, and the five planets were regarded as representing the activity of the five gods in question, together with the Moon God, and the Sun God, in preparing the occurrences on earth. If one could interpret the activity of these powers, one knew what the gods were aiming to bring about. The Babylonian Priests accordingly applied themselves to perfecting a system of interpretation of the phenomena to be observed in the heavens, and it was natural that the system should be extended from the Moon, Sun and five planets to the more prominent and recognisable fixed stars. The interpretations were based



largely on the recollection, or on written records, of what had taken place in the past. Some striking event, fortunate or disastrous, had coincided with the appearance of some rather unusual astronomical phenomenon ; in future such a phenomenon was regarded as portending, not necessarily an exactly similar event, but a correspondingly favourable or unfavourable one. By degrees a mass of traditional interpretation of all kinds of observed phenomena was gathered and became a guide to the Priests.

The Babylonians confined their predictions based on their observations of the heavens, to events affecting the welfare of the nation as a whole, or of its rulers ; they rarely referred them to private individuals. By the Greeks and the later Egyptians both Astrology and Astronomy were carried far beyond the limits reached by the Babylonians, and in addition to making many really scientific discoveries the Greeks amplified and developed in a most elaborate manner the theory of the influence of the planets on the fate of human beings.

They originated the practice of tracing the Horoscope of an individual from the position of the planets and stars at the time of his birth, and for centuries men consulted Astrologers when planning any great enterprise for themselves or arranging for the career of their children. The Astrologers picked out lucky days for the

commencement of any kind of business. They told fortunes, they resolved questions, they recovered stolen goods ; they predicted future events. It is, however, apparent from their own writings that they had little confidence in the stars and that "judicial astrology" was for the most part guess work not unaccompanied by fraud. Later on Newton pointed out that the stars were distant worlds, which could have no power over the destiny of men.

Astrology was one of the favourite superstitions of Shakespeare's time, and the belief in it has not, by any means, completely died out, even in the most advanced communities. At the same time it is difficult to believe how anyone in the present day, who possesses the most elementary knowledge of modern Astronomy, can fail to see how utterly opposed both to reason and common sense are the foundations of this false and foolish so-called Science.

In Shakespeare's Plays there are many references to it. "The numerous allusions to the practice of Astrology, the striking metaphors, and apt illustrations scattered throughout the plays of Shakespeare, at once attest his intimate acquaintance with the general principles of the science, and the popularity of astrological faith. In his age to doubt it was scepticism, as to believe it now is superstition.\*

\* (Mr John Cook in Macmillan's Magazine).



Whether Shakespeare believed in it or not is a matter of little moment ; but he has left us sufficient evidence to show that he was largely influenced by a subject which has left indelible marks on the language and literature of England.

KING LEAR. *Act 1. Scene 1.*

For, by the sacred radiance of the sun ;  
The mysteries of Hecate and the night ;  
By all the operations of the orbs,  
From whom we do exist, and cease to be ;  
etc.

We may infer that Shakespeare was not a believer in Astrology, though he uses it for poetic and dramatic purposes.

SONNET 14.

Not from the stars do I my judgment  
pluck,  
And yet methinks I have astronomy,  
But not to tell of good or evil luck,  
Of plagues, of dearths, or seasons quality.

PERICLES. *Act 3. Scene 1.*

Thou hast as chiding a nativity  
As fire, air, water, earth, and heaven can  
make,  
To herald thee from the womb.

TITUS ANDRONICUS. *Act 2. Scene 3.*

Madam, though Venus govern your desires,  
Saturn is dominator over mine.

CYMBELINE. *Act 5. Scene 1.*

Our jovial star reigned at his birth.

KING LEAR. *Act 4. Scene 3.*

It is the stars,

The stars above us, govern our conditions ;  
Else one self-mate and mate could not be-  
get.

Such different issues.

CYMBELINE. *Act 3. Scene 2.*

O, learn'd indeed were that astronomer,  
That knew the stars, as I his characters ;  
He'd lay the future open.

The idea that the stars exercise some influence for good or evil over the birth of individuals was widely prevalent in the seventeenth Century, and Shakespeare simply conforms to the ideas of the times when he says in :—

KING RICHARD III. *Act 4. Scene 4.*

Lo ! at their birth good stars were opposite.

TIMON OF ATHENS. *Act 4. Scene 3.*

Be as a planetary plague, when Jove  
Will o'er some high-iced city hang his  
poison,  
In the sick air.

SONNET 26.

Till whatsoever star that guides my moving  
Points on me graciously with fair aspect.

ANTONY AND CLEOPATRA. *Act 3. Scene 2.*

And at this time most easy 'tis to do't,

When my good stars that were my former  
guides,  
Have empty left their orbs, and shot their  
fires  
Into the abyss of hell.

HAMLET. *Act I. Scene I.*

A little ere the mightiest Julius fell,  
Stars shone with trains of fire, dews of  
blood  
Disasters in the sun ; and the moist star,  
Upon whose influence Neptune's empire  
stands,  
Was sick almost to doomsday with eclipses.

TITUS ANDRONICUS. *Act 2. Scene 4.*

If I do wake, some planet strike me down,  
That I may slumber in eternal sleep.

HAMLET. *Act I. Scene I.*

The nights are wholesome, then no planets  
strike  
No fairy takes, nor witch hath power to  
charm.

TEMPEST. *Act I. Scene 2.*

And by my prescience  
I find my zenith doth depend upon  
A most auspicious star, whose influence  
If now I court not, but omit, my fortunes  
Will ever after droop.

LOVE'S LABOUR LOST. *Act 5. Scene 2.*

Thus pour the stars down plagues for per-  
jury.

TROILUS AND CRESSIDA. *Act 1. Scene 3.*

The Heavens themselves, the Planets, and  
this centre

Observe degree, priority, and place,  
The glorious Planet Sol, whose med'cinable  
eye

Corrects the ill aspects of planets evil,  
. . . . But when the planets  
In evil mixture, to disorder wander,  
What plagues, and what portents, etc.

### THE HEAVENLY ALCHEMY.

SONNET 33.

Full many a glorious morning have I seen  
Flatter the mountain tops with sovereign  
eye,

Kissing with golden face the meadows  
green,

Gilding pale streams with heavenly alchemy

In this Sonnet Shakespeare only uses the word  
"Alchemy" to describe the beautiful change  
made by the brilliant light of the morning sun.

Shakespeare's age was extremely addicted  
to the practice of Alchemy, and Ben Jonson's  
comedy, "The Alchemist" was a very suitable  
satire on the prevalent foible of the time, for among

the few genuine professors there were innumerable imposters.

KING JOHN. *Act 3. Scene 1.*

To solemnise this day, the glorious sun  
Stays in his course, and plays the alchemist ;  
Turning, with splendour of his precious eye,  
The meagre cloddy earth to glittering gold.

The history of popular delusions cannot provide us with one more striking than Alchemy, the pretended art of making gold and silver, or transmuting the base metals into noble ones.

Every age has its own folly and delusions, but for more than a thousand years this art captivated many noble minds and was believed in by millions who spent their time seeking for the Philosopher's Stone, and the Water of Life.

The Alchemists, in trying to establish a false science, laid the foundations of chemistry, and in the same way the Baconians, in attempting to establish a false theory, have contributed to a truer knowledge and a deeper understanding of the life of the man William Shakespeare, whom they are vainly trying to discredit.

In reality Bacon added little to the World's knowledge. He appears to have been theoretically an Alchemist, as he seems to have been a believer in the transmutation of metals, and solemnly gives a formula for changing silver or copper into gold, and he also believed in the transmutation of plants.

## PLANETARY INFLUENCE AND CELESTIAL PORTENTS.

For many centuries the most superstitious ideas obtained among even the most enlightened people in regard to the supposed influence of the stars, and it was a common thing for men to attribute good fortune to a "good star," while their misfortunes and evil actions were supposed to be the result of having been born under an unlucky star.

These superstitious ideas still held sway in the days of Shakespeare. No doubt it was comforting for the morally weak to be able to transfer the responsibility for their wrong doing to some evil planetary influence !

In England Swift may claim to have given the death blow to Astrology by his satire of " Prediction for the year 1708, by Isaac Bickerstaff, Esq." But such fallacies die hard, and in our twentieth Century ignorant foolish people have been known to pay large sums for the casting of their horoscope.

Shakespeare, no doubt, adopted the theory of the influence of the stars over human life, just as he did the theory of the supernatural power of witches, ghosts, and fairies.

Without expressing any opinion, he simply used all such notions as a means of giving interest to his plays, because it served his purpose in this way to connect the outer world with the

physical and mental condition of his characters.  
“ All’s Well that Ends Well ” seems to be the most astrological of Shakespeare’s plays.

Helena taunts Parolles with being born under Mars.

ALL’S WELL THAT ENDS WELL. *Act I. Scene I.*

*Helena.*

Monsieur Parolles, you were born under  
a charitable star

*Parolles*

Under Mars! . . . When he was pre-  
dominant.

*Helena.*

When he was retrograde, I think, rather.

*Parolles.*

Why think you so ?

*Helena.*

You go so much backward when you fight,  
etc.

Helena argues with herself about this belief in planetary influence.

*Helena* says in *Act I. Scene I.*, of the same play :—

Our remedies oft in ourselves do lie

Which we ascribe to heaven, the fated sky

Gives us free scope, only doth backward

pull

Our slow designs when we ourselves are

dull.

But she evidently clings to her faith :—

There’s something hints



More than my father's skill, which was the  
greatest  
Of his profession, that his good receipt  
Shall for my legacy, be sanctified  
By the luckiest stars in heaven.

*Act I. Scene 3.*

We find Shakespeare reflecting the ideas of his day, on this subject as on others, in the words which he puts into the mouths of Characters in his plays.

Prospero in "THE TEMPEST" says his

Zenith doth depend upon  
A most auspicious star.

In KING LEAR the Earl of Kent, full of wonder at the contrast between Cordelia and her sister exclaims :

It is the stars,  
The stars above govern our conditions,  
Else one self-mate and mate could not beget  
Such different issues !

Mark Antony, when misfortune overwhelms him, says :—

My good stars that were my former guides  
Have empty left their orbs and shot their  
fires  
Into the abyss of hell."

The question arises whether Shakespeare himself shared in the superstitious ideas of his day on the subject of planetary influence and celestial signs and portents. He was a man far



ahead of his times in many ways and we should certainly expect to find him ahead of it in this. But, it may be objected, we have seen again and again these foolish ideas voiced by the characters in his plays, was he not also expressing his own opinions on the subject? This is highly improbable—A writer would naturally make his characters think and speak as the men of their day thought and spoke, even though he himself might not always agree with their ideas. But he would hardly make them run counter to the opinions of their day, and even hold them up to ridicule unless he were voicing his own strong convictions.

And Shakespeare does this. Cassius in *Julius Cæsar*, *Act I, Scene 2*, trying to stir up Brutus' resentment of Cæsar's overwhelming supremacy reasons with him thus :

“ The fault, dear Brutus, is not in our Stars,  
But in ourselves that we are underlings.”

Edmund's comment may well have been the expression of Shakespeare's own views.

KING LEAR. *Act I. Scene 2.*

He thus soliloquises :—“ This is the excellent foppery of the world, that when we are sick in fortune—often the surfeit of our own behaviour—we make guilty of our disasters the sun, the moon, and the stars, as if we were villains by necessity, fools by heavenly compulsion ; thieves, knaves,

treachers by spherical predominance, drunkards, liars, and adulterers by an enforced obedience of planetary influence—an admirable evasion of man to lay his goatish disposition to the charge of a star.”

In these passages “ spherical predominance ” like “ disasters ” and “ influence ” were all astrological terms.

Shakespeare’s ridicule can be seen in Hotspur’s sarcastic reply to the bombastic speech of Glendower in which he says,

“ At my nativity,  
The front of heaven was full of fiery shapes,  
Of burning cressets ; and, at my birth,  
The frame and huge foundation of the earth  
Shak’d like a coward.”

Hotspur, not in the least impressed, replies :  
“ Why, so it would have done at the same season, if your mother’s cat had but kittened, though yourself had never been born,” etc.

I HENRY IV. *Act 3. Scene 1*

The poet’s ridicule in passages of this kind gives the impression that Shakespeare shared the opinions of the more enlightened minds of his time. One of those exponents was Phillip Stubbes) whose “ Anatomie of Abuses in England,” (1583, deals at length with “ a certeine kind of curious people and vaine glorious called astronomers and

astrologers, the corruptions and abuses of whom are inexplicable." In his quaint language he goes on to show that their science is founded only on guesses and stargazing, and he describes how the " foolish star tooters " foretold fearful events for a certain date in 1583, and yet everything passed off quietly as usual. Expressing himself like Edmund in *King Lear* he maintains that " it is the malice of the devill, the corruption of our nature, and the wickedness of our owne harts, that draweth us to evill, and so to shameful destinies and infamous ends, and not the starres or planets."

Malvolio expresses the popular sentiment in this passage :—

TWELFTH NIGHT. *Act 2. Scene 5.*

In my stars I am above thee ;  
But be not afraid of greatness, etc.

In this passage Malvolio is only reading the letter dropped for him by Maria.

As to the current belief in Astrology we may remember that about the time when the plays were written, Dr. Dee was grieving for his lost patroness, Queen Elizabeth ; that the profligate court of James I. was in 1618 frightened by the appearance of a comet into a temporary fit of gravity ; and that even Charles I. sent £500 as a fee to William Lilly for consulting the stars as to his flight from Hampton Court, in 1647.

## THE STARS.

What teacher is there like the stars to enforce the lesson of man's littleness—to humble man's pride? And here, of course, the familiar words come to mind, "When I consider thy heavens, the work of thy fingers, the moon and the stars which thou hast ordained; what is man, that thou art mindful of him, and the son of man, that thou visitest him? (Psalm viii. 3, 4.) Then again, to take the opposite side of the picture, what subject more illustrates the dignity and greatness of man? Dwellers are we on this tiny globe—a mere grain of sand in view of the mighty orbs around us, and yet to have pried with magnificent daring into the secrets of the universe; to have made not only our globe, but other bodies, millions upon millions of miles distant, deliver up the secret of their distance, density, weight, composition; and even to have aspired to guess at their birth, their stages of growth and their death—in view of all this, what mighty factors are the mind and imagination of man! How much more cause have we, in this day, than Hamlet had in his day, as we look on "this brave o'erhanging firmament, this majestical roof fretted with golden fire," to exclaim, "What a piece of work is a man, how noble in reason, how infinite in faculties . . . in apprehension how like a god!"

ANTONY AND CLEOPATRA. *Act 3. Scene 2.*

Let all the number of the stars give light  
To thy fair way.

HAMLET. *Act 4. Scene 7.*

*King.*

She (the Queen) is so conjunctive to my  
life and soul,  
That as the star moves not but in his  
sphere,  
I could not but by her.

ALL'S WELL THAT ENDS WELL. *Act 1. Scene 1.*

If Bertram be away, it were all one  
That I should love a bright particular star,  
And think to wed it, he is so above me ;  
In his bright radiance and collateral light  
Must I be comforted, not in his sphere.

TAMING OF THE SHREW. *Act 4. Scene 5.*

What stars do spangle heaven with such  
beauty,  
As those two eyes become that heavenly  
face ?

SONNET 21.

“ Those gold candles fix'd in heaven's air.”

MIDSUMMER NIGHT'S DREAM. *Act 3. Scene 2.*

Yet you, the murderer, look as bright, as  
clear,  
As yonder Venus in her glimmering sphere.

I HENRY IV. *Act 5. Scene 4.*

Two stars keep not their motion in one  
sphere ;

Nor can one England brook a double reign  
Of Harry Percy and the Prince of Wales.

WINTER'S TALE. *Act 1. Scene 2.*

Though you would ask t'unsphere the stars  
with oaths.

ROMEO AND JULIET. *Act 3. Scene 2.*

Give me my Romeo, and when he shall die,  
Take him and cut him out in little stars,  
And he will make the face of heaven so fine,  
That all the world will be in love with night,  
And pay no worship to the garish sun.

HAMLET. *Act 2. Scene 2.*

Doubt thou the stars are fire,  
Doubt that the Sun doth move.

I HENRY IV. *Act 2. Scene 1.*

Charles' Wain is over the new chimney,—  
The great Bear was popularly known as  
Charles' Wain.

## FIXED STARS.

The most numerous bodies which we see in the heavens are called "Fixed Stars." They are at an immense and almost inconceivable distance from us, and very little is known respecting them. They are generally supposed to be suns like our



own, each the centre of another system. Their number is almost incalculable. Those which can be seen on a clear night with the naked eye amount to about three thousand. With a powerful telescope this number is increased to an inconceivable extent. These stars are distributed into Constellations which are named from some fancied resemblance to various objects.

From the nearest of the Fixed Stars light, which travels eight times round the world in a second, would take  $4\frac{1}{2}$  years to reach us ; while from some of the most distant it is supposed that light would take thousands of years to reach us.

The term “ Fixed Stars ” is a gigantic misnomer. They are all in motion, some moving at the rate of 200 miles a second, but their distances are so immense that it would take Centuries to note any change in their positions. They are called “ fixed ” because they appear to keep their relative positions, as distinguished from the “ planets ” whose name is derived from the Greek “ planetes,” a wanderer.

KING RICHARD II. *Act 2. Scene 4.*

And Meteors fright the fixed stars of  
heaven,

The pale faced moon looks bloody on the  
earth.

. . . . These signs forerun the death or  
fall of Kings.

## SHOOTING STARS.

In addition to the planets and their satellites, and the number of comets, there are numerous other small bodies generally recognised as existing in space.

The study of these small bodies is a branch of astronomy in which the telescope is of but little use.

We do not see these bodies under ordinary circumstances with the telescope, but we become aware of their existence in other ways.

We sometimes find them actually falling down upon the earth ; we can take them in our hands, weigh them and analyse them ; they are the bodies which we call Meteorites. Collections of these objects are to be seen in the British Museum and elsewhere.

The old belief was that " shooting stars " were stars actually falling from the sky. This view is expressed by a text in the Book of Revelation (vi., 13). " And the stars of heaven fell unto the earth, even as a fig tree casteth her untimely figs when she is shaken of a mighty wind." The old idea about the stars was that they were little solid bright bodies fixed into a solid vault called the sky or firmament. We now know that the stars are suns, many of them infinitely larger than our sun, and the idea of these falling in a shower upon our tiny globe is, in view of our present knowledge, ludicrously absurd.



What, then, are shooting stars? The view now generally held is that they are, for the most part, very small bodies, not larger than pebbles, or even like grains of sand. The universe is full of them. The number that daily plunge into our atmosphere is reckoned by millions. From this ceaseless cannonade our atmosphere protects us. Our earth, moving at the rate of 1,000 miles an hour meets these bodies, also moving at about the same rate. The collision is terrific, the friction first produces heat, and then light, which makes the object visible. The shock vapourises it or pulverises it. Most become fused in the upper regions of the air. A few escape pulverisation and fall on the earth as aerolites or meteorites.

KING RICHARD II. *Act 2. Scene 4.*

Ah ! Richard, with the eyes of heavy mind,  
I see thy glory, like a shooting star  
Fall to the base earth from the firmament.

HENRY VIII. *Act 4. Scene 1.*

These are stars indeed,  
And sometimes falling ones.

MIDSUMMER NIGHT'S DREAM. *Act 2. Scene 2.*

. . . . a mermaid on a dolphin's back,  
Uttering such dulcet and harmonious breath  
That the rude sea grew civil at her song,  
And certain stars shot madly from their  
spheres

To hear the sea-maid's music.

## METEORS.

The only difference between a shooting star and a meteor is one of size. The number of these bodies which the earth encounters every day of the year is estimated to be several millions. But so small are these "bodies" that, in spite of this great number, the whole lot together would probably not weigh a hundred tons. Sometimes of course, a meteor will reach the earth.. The most venerated of all the stones that "Fell from heaven" is to be found in the Great Mosque of Mecca. Known as the "Black Stone" it is built into the wall of the Ka'aba, and all the thousands of pilgrims that flock to the sacred city would consider their pilgrimage futile unless they kissed this stone of heaven.

I HENRY IV. *Act 5. Scene 1.*

My Lord of Worcester . . . will you again  
unknit

This churlish knot of all-aborred war ?  
And move in that obedient orb again,  
Where you did give a fair and natural light ;  
And be no more an exhal'd meteor,  
A prodigy of fear, and a portent  
Of broached mischief to the unborn times ?

KING JOHN. *Act 5. Scene 2.*

And makes me more amazed  
Than had I seen the vaulty top of heaven  
Figur'd quite o'er with burning Meteors.

## THE MUSIC OF THE SPHERES.

It has already been stated that the ancient system of Astronomy taught that the heavenly bodies moved round the earth, fixed in Crystal spheres. It was thought that, as the spheres revolved, music was given forth, which the ears of mortals were too dense to hear.

This beautiful fancy is recorded in Milton's Hymn to the Nativity, " Ring out, ye crystal spheres " and by Shakespeare in several passages. The following passage it would be difficult to surpass in the whole range of our literature.

MERCHANT OF VENICE. *Act 5. Scene 1.*

How sweet the moonlight sleeps upon this  
bank !

Here will we sit, and let the sounds of  
music

Creep in our ears ; soft stillness and the  
night

Become the touches of sweet harmony.

Sit, Jessica, look how the floor of heaven  
Is thick inlaid with patines of bright gold ;  
There's not the smallest orb which thou  
behold'st

But in his motion like an angel sings,  
Still quiring to the young-eyed cherubims ;  
Such harmony is in immortal souls ;  
But, whilst this muddy vesture of decay  
Doth grossly close it in, we cannot hear it.

Some of Shakespeare's other mentions of spheres are :—

MIDSUMMER NIGHT'S DREAM. II. *i*, 155.

“ And certain stars shot madly from their  
spheres,  
To hear the sea-maids music.”

ROMEO AND JULIET. II. *ii*. 157.

Two of the fairest stars in all the heaven,  
Having some business, do entreat her eyes  
To twinkle in their spheres till they return.”

KING JOHN V. *vii*. 74.

“ Now, now, you stars that move in your  
night spheres  
Where be your powers ? ”

ALL'S WELL. I. *i*. 100.

In his radiance and collateral light  
Must I be comforted, not in his sphere.”

HAMLET. IV. *vii*. 15.

“ She's so conjunctive to my life and soul  
That, as the star moves not but in his  
sphere  
I could not but by her.”

TEMPEST. II. *i*. 183.

“ You would lift the moon out of her sphere,  
if she would continue in it five weeks  
without changing.”

Bartholomew de Glanvilla, the authority on the subject of natural philosophy in the middle ages, in his work “ De Proprietatibus Rerum ”

translated by Trevisa in Chaucer's day and published by Thomas Barthelet in 1535, says that :—

Wise men tell that of meeting of roundnesses, and of contrary moving of Planets cometh a sweet harmony :

. . . In putting and moving of these round worlds cometh the sweet sound and accord."

PERICLES. *Act 5. Scene 1.*

*Pericles.* But what music ?

*Helena.* My Lord, I hear none.

*Pericles.* None !

The music of the spheres ! List  
my Marina.

ANTONY AND CLEOPATRA. *Act 5. Scene 2.*

His voice was propertied  
As all the tuned spheres.

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ANTONY AND CLEOPATRA. *Act 4. Scene 13.*

" O Sun,  
Burn the great sphere thou mov'st in !  
darkling stand  
The varying shore o' the world."

AS YOU LIKE IT. *Act 2. Scene 7.*

If he, compact of jars, grows musical  
We shall have shortly discord in the  
spheres.

In *A Midsummer Night's Dream Act II. Sc. 1*,  
the Fairy makes an allusion to the belief that the  
Spheres revolved

(i)

as the Ptolemaic system taught :—

“ I do wander everywhere

Swifter than the moon's sphere.”

(i) See a paper by F. J. Furnivall on this topic in the Transactions of the New Shakespeare Society, 1877—9 pp. 431—450.

## COMETS.

Besides the planetary bodies there are a number of bodies moving round the sun in very eccentric orbits, called “ Comets.” Few objects have excited more speculations among the learned and more wonder and dread among the ignorant. Several hundred Comets are on record as having appeared at different times ; and the size, appearance and distances of all of them vary considerably. Their ordinary aspect is that of a brilliant but ill-defined mass of light, which is usually much brighter at the head. From the head diverge two or more streams of light, which sometimes unite again at a little distance from it and sometimes continue distinct ; this is termed the tail.

Comets, meteors, and shooting stars may, in a sense, be called the “ lawless ” members of the heavens. But only in a sense, for “ nothing is that errs from law.”

The laws governing the origin, composition and movements of these bodies are as yet very



imperfectly understood. Comets particularly have, from the earliest times, been the objects of wonder and alarm.

Strange it is to reflect that the unforeseen and extraordinary should nearly always give rise to fear.

The rare and unusual appearance of comets, their rapid and irregular motion, enormous size, and the unexpected manner in which they burst upon us, cause this feeling.

From old prints we gather what extraordinary and frightful forms a terrified imagination could cause them to assume—javelins, swords of fire, bleeding crosses, flaming daggers, horses' manes, decapitated heads.

They were generally thought to be heralds of some great and dire event—the downfall of a kingdom, the death of a king, the outbreak of plague, the end of the world.

Comets are said to have appeared at the deaths of Constantine (A.D. 336), Attila (453), Mahomet (632), Richard I. (1198). The comet of 1665 was thought to have caused the Plague of London. A comet was said to be the cause of the Thirty Years War.

One appeared in B.C. 43, the year of Cæsar's death, and was said to be his spirit and to indicate his reception among the gods. One was mentioned by Josephus at the time of the siege of Jerusalem. A.D. 70.

In Shakespeare's plays there are several notable and very striking references to comets :—

I HENRY VI. *Act I. Scene 1.*

Comets importing change of times and  
states,

Brandish your crystal tresses in the sky.

JULIUS CÆSAR. *Act 2. Scene 2.*

When beggars die there are no comets seen ;  
The heavens themselves blaze forth the  
death of princes.

Here is another passage which is even more definite :—

I HENRY VI. *Act 3. Scene 2.*

Now shine it like a comet of revenge,  
A prophet to the fall of all our foes !

In the following passage we have a more general and clear allusion to the results which follow the appearance of a Comet :—

TAMING OF THE SHREW. *Act 3. Scene 2.*

Some Comet or unusual prodigy.

## THUNDER-BOLT AND THUNDER-STONE.

There is often a misunderstanding connected with these words. A thunderbolt is a shaft of lightning, a stream of electricity, passing from one part of the heavens to another, and from the clouds to the earth.

A thunder-stone may mean a meteorite, but



meteorites are connected with “ shooting stars ” and have nothing to do with thunder storms or atmospheric electricity.

CYMBELINE. *Act 4. Scene 2.*

Fear no more the lightning-flash,  
Nor the all-dreaded thunder-stone.

TEMPEST. *Act 2. Scene 2.*

An islander, that hath lately suffered by a  
thunder-bolt.

### SIGNS OF THE ZODIAC.

The Zodiac is the celestial zone—a pathway in the sky—about sixteen degrees in width, which the sun, moon, and planets traverse in the course of the year. It is divided into twelve parts, called “ Signs,” each of which embraces a constellation. Their names are Aries (the Ram), Taurus (the Bull), Gemini (the Twins), Cancer (the Crab), Leo (the Lion), Virgo (the Virgin), Libra (the Scales), Scorpio (the Scorpion), Sagittarius (the Archer), Capricornus (the Goat), Aquarius (the Water-bearer), Pisces (the Fishes).

LOVE’S LABOUR’S LOST. *Act 5. Scene 2.*

There stay, until the twelve celestial signs  
Have brought about their annual reckoning.

TITUS ANDRONICUS. *Act 2. Scene 1.*

As when the golden sun salutes the morn,  
And, having gilt the ocean with his beams,

Gallops the zodiac in his glistening coach,  
And overlooks the highest-peering hills  
So Tamora, etc.

TITUS ANDRONICUS. *Act 4. Scene 3.*

The good boy in Virgo's lap.

This refers to the Mediæval representation  
of the sign as the Madonna and Child,

### POLE STAR.

JULIUS CÆSAR. *Act 3. Scene 1.*

But I am constant as the northern star,  
Of whose true-fix'd and resting quality  
There is no fellow in the firmament.

The Pole Star is a very bright star in the  
constellation Ursa Minor, which being situated  
very close to the North Pole is of incalculable  
service to navigators.

OTHELLO. *Act 2. Scene 1.*

The wind-shak'd surge, with high and  
monstrous mane,  
Seems to cast water on the burning Bear,  
And quench the guards of the ever-fixed  
Pole.

The North Polar Star may easily be found  
by means of the well-known constellation of the  
Great Bear.

The two outer stars of the square in that  
constellation called the "Pointers" point to the  
Pole Star a short distance away. The Celestial

Poles indicate the points in the heavens which the axis of the earth, if extended, would touch. The Pole Star is not stationary ; it very slowly describes a circle in the heavens the diameter of which is about 50 degrees, taking 26,000 years to make the circuit. The consequence of this is that our present Pole Star will not always be the Pole Star.

At present we are fortunate in having so conspicuous a star to mark the north point of the heavens. The southern hemisphere has no bright star near to the South Pole. In the course of 13,000 years, when the terrestrial pole has run through about half its circuit, the bright star Vega in the constellation Lyra will constitute a fine Pole Star. Even now the North Pole of the earth does not point exactly to the Pole Star. The two points are about a degree and a half apart.

## VENUS.

Venus is mentioned 21 times in Shakespeare's plays, and is the brightest and most beautiful of all the planets. She never appears more than 48 degrees distant from the sun, so that she is never seen more than  $3\frac{1}{2}$  hours before or after him. When she is west of the Sun she rises before him, and is a morning star ; and when east of him, an evening star, as she is then seen after he sets. When viewed with a telescope, she presents, in

common with Mercury, the same appearance as the Moon ; being crescent-shaped, or round, according to her situation.

Venus is distant from the Sun about 68 million miles ; her time of revolution around him is about 225 days, and she moves at the rate of 80,000 miles an hour. Her diameter is 7,800 miles ; rather less than that of the Earth ; and she is believed to revolve on her axis in about  $23\frac{1}{2}$  hours.

When either Venus or Mercury passes between the Earth and the Sun, the enlightened side is turned from us, and the planets, when in this position, are occasionally seen as black spots passing across the Sun's disk. This, however, happens very seldom, owing to the inclination of their orbits to the Ecliptic.

## THE OTHER PLANETS IN SHAKESPEARE'S PLAYS.

Saturn is mentioned 5 times ; Jupiter is mentioned 30 times ; Mars is mentioned 36 times ; Mercury is mentioned 15 times.

The planet Uranus was discovered by Sir William Herschel in 1781, and later on the planet Neptune was discovered in 1846.

# THE ASTRONOMY OF PARADISE LOST.

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Milton is another of our great writers who makes numerous references to celestial objects, and in these notes on the Astronomy of "Paradise Lost" it must be distinctly understood that the "astronomy" of the poem alone is dealt with. No reference is made to the Theology or to the general character of this great work. One quotation only from Addison will be given. He thus writes in the "Spectator," No. 321, "The Paradise Lost, is looked upon by the best judges, as the greatest production, or at least the noblest work of genius, in our language." The reader is warned not to take the astronomical passages as favourable specimens of the beauty of the poem.

In the compilation of these notes the writer is much indebted to the valuable notes of Professor Masson in his edition of Milton. Some helpful diagrams are to be found there.

The poem describes the idea that, before the creation of our earth and the universe, universal space is to be considered as divided into two hemispheres. The upper of these is Heaven, or the Empyrean, a boundless region of light, happiness and glory, the abode of the Deity and his angels. The lower hemisphere is Chaos. This

was an uninhabited region, "a huge boundless ocean, abyss, or quagmire, of universal darkness and lifelessness, wherein are jumbled in blustering confusion the elements of all matter, or rather the crude embryos of all the elements, ere as yet they are distinguishable." The crystal floor of Heaven divides the two regions.

When Satan and the rebel angels fell and were cast out of Heaven, this crystal floor opens wide, rolling inwards, and the rebel crew

The Almighty power  
Hurl'd headlong flaming thro' from th'  
ethereal sky  
With hideous ruin and combustion, down  
To bottomless perdition, there to dwell  
In adamant chains and penal fire  
Who durst defy the Omnipotent to arms.  
(Bk. I, L. 44).

Here another region is introduced-Hell. It is a space carved out of Chaos. Its exact position is defined:

As far removed from God and light of  
heaven

As from the centre thrice to th' utmost pole.

The "centre" here means the centre of the earth. The distance then from Heaven to Hell was three semi-diameters of the earth; that is 12,000 miles. It is possible that the "celestial" pole may be intended, if so, a few extra miles, in accordance with the then prevailing ideas of



distance, would have to be added. What strange ideas of celestial distances! only some 12,000 miles from Heaven to Hell!

Homer locates Hell at a spot as far beneath the earth as the earth is beneath Heaven. Virgil makes it twice as far.

In Bk. 6, L. 871 we are told that the rebel angels took nine days to fall from Heaven to Hell. This would be at the rate of 55 miles an hour!

They reach hell. Nine days they lay stupified and bewildered in the fiery gulf. During this period a great event is happening elsewhere. There had been talk in Heaven of a new race of beings to be created; now, in order to repair the loss caused by the defection of the rebel host—one-third of the angels—the purpose was to take effect. Another space is carved out of Chaos, and the World is created and Man.

We return to Satan and his army. After a few days they partly recover from their stupor, roused by the spirit and call of their leader. After long and various debate, Satan suggests that an effort be made to find out the new World that rumour says has lately been created, and Satan himself offers to undertake the journey.

Long is the way  
And hard, that out of Hell leads up to  
light.  
Our prison strong, this huge convex of fire,  
Outrageous to devour, immures us round



Ninefold ; and gates of burning adamant,  
Barred over us, prohibit all egress.  
These passed, if any pass, the void profound  
Of unessential Night receives him next,  
Wide-gaping and with utter loss of being  
Threatens him, plunged in that abortive gulf.  
If thence he scape, into whatever world,  
Or unknown region, what remains him less  
Than unknown dangers, and as hard  
escape ?

*(Bk. 2. L. 432, etc.)*

Satan starts ; he reaches Hell-gate, which is  
guarded by Sin and Death. Satan induces them  
to let him pass. He reaches the realm of Chaos,

When straight behold the throne  
Of Chaos, and his dark pavilion spread  
Wide on the wasteful Deep ! With him  
enthroned

Sat sable-vested Night, eldest of things,  
. . . . Rumour next, and Chance,  
And Tumult, and Confusion, all embroiled,  
And Discord with a thousand various  
mouths.

*(Bk. 2. L. 959, etc.)*

Chaos directs Satan to the Earth ; he pursues  
his journey. At length he beholds

Far off the empyreal Heaven, extended wide  
In circuit, undetermined square or round,  
With opal towers and battlements adorned  
Of living sapphire, once his native seat,

And, fast by, hanging in a golden chain,  
This pendant World, in bigness as a star  
Of smallness magnitude close by the moon.  
Thither, full fraught with mischievous  
revenge,  
Accurst, and in a cursed hour, he hies.

(*Bk. 2. L. 1047, etc.*)

So much by way of introduction. We will now investigate the subject of Milton's astronomical ideas.

*important* The subject is invested with special interest from the fact that Milton lived just in the age of transition between the old ideas, which for hundreds of years (from the beginning we may say) had held sway, and the new doctrines.

It is not necessary to repeat what was said in the "Astronomy of Shakespeare." Just a further word on the subject of the "crystal spheres" may be necessary. In one passage Milton speaks of *ten* spheres. In *Bk. 3, L. 481, etc.* he says, describing people ascending from the Earth:

They pass the planets seven, and pass the  
fixed,

And that crystalline sphere whose balance  
weighs

The trepidation talked, and that first  
moved ;

"The planets seven" were the Sun and Moon and the five then known planets ; "the Fixed"

meant of course the "Fixed Stars;" and "that First moved" was the Primum Mobile. There is more difficulty in interpreting "that Crystal-line Sphere" etc. It probably means, a sphere with slow motion that caused the movement known as "the Precession of the Equinoxes".

Elsewhere, in the "Hymn on the Nativity" and in "Arcades," Milton speaks of *nine* spheres. Dante has nine spheres and the Empyrean, ten in all.

In the history of progress we note certain periods when the hour seems to strike for the advent of some great step in the onward, march of civilization and progress. No epoch in the history of the world is of more profound significance than that which goes by the name of "the Renaissance." It began in the 12th and reached its climax in the 15th and 16th Centuries. Previous to this, a shadow of darkness and of night seems to have lain over the civilised world for many Centuries, embracing a period called the "Dark Ages" or the "Middle Ages." One of the chief features of this great movement was the advent of the New Astronomy. The line separating the old and the new is drawn about the year 1600.

A fine quotation from Froude's History of England may here be given: "For, indeed, a change was coming upon the world, the meaning and direction of which, even still is, hidden from us, a change from era to era. The paths trodden

*a new world was  
calling.*

by the foot-steps of the ages were broken up ;  
old things were passing away, and the faith and  
the life of ten Centuries were dissolving like  
a dream. Chivalry was dying ; the abbey and the  
castle were soon together to crumble into ruins,  
and all the forms, desires, beliefs, convictions of  
the old world were passing away, never to return.  
A new continent had risen up beyond the western  
sea. The floor of the heaven, inlaid with stars,  
had sunk back into an infinite abyss of immeasurable  
space ; and the firm earth itself unfixed from  
its foundations, was seen to be but a small atom  
in the awful vastness of the universe."

To return to our immediate subject, Professor  
Masson says, " In Milton's case we are presented  
with the interesting phenomenon of a mind appar-  
ently uncertain to the last which of the two systems,  
the Ptolemaic or the Copernican, was the true one,  
or perhaps beginning to be persuaded of the higher  
probability of the Copernican, but yet retaining  
the Ptolemaic for poetical purposes. For Milton's  
life (1608—1674) coincides with the period of the  
struggle between the two systems."

Great revolutionary doctrines often take long  
before they secure general acceptance. " Paradise  
Lost " was written about the middle of the 17th  
Century. The poet was well versed in the best  
learning of the day, and yet, in the poem, we  
see him obviously "sitting on the fence," not  
knowing which view to adopt ; and so in the poem

we find both views given. The old view is given in a passage already quoted. There is another passage where the old view is indicated.

Satan has reached the Earth and  
from inward grief  
His bursting passion into plaints thus  
poured :—

“ O Earth, how like to Heaven,

. . . . .

Terrestrial Heaven, danced round by other  
Heavens,

That shine, yet bear their bright officious  
lamps,

Light above light, for thee alone, as seems,  
In thee concentrating all their precious beams  
Of sacred influence ! As God in Heaven  
Is centre, yet extends to all, so thou  
Centring receiv'st from all those orbs ;

(*Bk. 9, L., 97, etc.*)

The old system retained its hold on the popular mind of Europe, and even in the scientific world, till the end of the 17th Century. It was not till the year 1835 that the doctrine was removed from the scholastic books of the Roman Catholic Church.

Milton was probably in advance of his contemporaries on this subject, and before the completion of his poem his Copernican ideas may have become decided. There are two passages where

comes over to one side.



he shows perfect acquaintance with the new theory.

In *Bk. 4, L., 555, etc.*, the Archangel Uriel, from the sun, of which he was regent, "through the even, on a sunbeam" descends to Gabriel, who has charge of Eden and warns him against a visit from Satan. Uriel then returns to the Sun which had set

Beneath the Azores ; whither the Prime  
Orb,

Incredible how swift, had thither rolled  
Diurnal, or this less volubil (turning slower)  
Earth,

By shorter flight to the east, had let him  
there

Arraying with reflected purple and gold

The clouds that on his western throne attend

Refer also to *Bk. 8, L., 15, etc.* Here Adam, in his conversation with the archangel Raphael in Eden, expresses doubts that have occurred to his mind in connection with the old system of astronomy. Raphael's answer is significantly vague. He will not commit himself to either system. It is quite an answer for a "transition" period.

*Milton himself comes out in the last*

"To ask or search I blame thee not ; for of work

Heaven

*Raphael becomes Milton's ideas*

Is as the Book of God before thee set,

Wherein to read his wondrous works, and  
learn

His seasons, hours, or days, or months, or  
years.

This to attain, whether Heaven move or  
Earth

Imports not, if thou reckon right ; the rest  
From man or angel the great Architect  
Did wisely to conceal, and not divulge  
His secrets, to be scanned by them who  
ought

Rather admire.

. . . . . What if the Sun  
Be centre to the world, and other stars,  
By his attractive virtue and their own  
Incited, dance about him various rounds ?  
Their wandering course, now high, now low,  
then hid

Progressive, retrograde, or standing still,  
In six thou seest ; and what if, seventh to  
these,

The planet Earth, so steadfast though she  
seems

Insensibly three different motions move ;

. . . . .

But whether thus these things, or whether  
not—

Whether the Sun, predominant in Heaven,  
Rise on the Earth, or Earth rise on the Sun ;  
He from the east his flaming road begin,  
Or she from west her silent course advance  
With inoffensive pace that spinning sleeps



On her soft axle, while she paces even,  
And bears thee soft with the smooth air  
along—

Solicit not thy thoughts with matters hid ;  
Leave them to God above ; him serve and  
fear.

. . . . . joy thou  
In what he gives to thee, this Paradise  
And thy fair Eve ; Heaven is for thee too  
high

To know what passes there. Be lowly wise ;  
Think only what concerns thee and thy  
being ;

Dream not of other worlds, what creatures  
there

Live, in what state, condition, or degree—  
Contented that thus far hath been revealed  
Not of Earth only, but of highest Heaven.”

Professor Masson's note on this is “ In this last passage Adam is represented as arriving by intuition at the Copernican theory, or at least as perceiving its superior simplicity over the Ptol-emaic ; and, though the drift of the Angel's reply is that the question is an abstruse one, and that it is of no great consequence for man's real duty in the world which system is the true one, yet the balance of the Angel's remarks is also Copernican. There is no doubt that these two passages were inserted by Milton to relieve his own mind on the subject, and by way of caution to the reader that

(the scheme of the Physical Universe adopted in the construction of the poem is not to be taken as more than a hypothesis for the imagination.”

Now Adam and Eve have fallen, and the curse pronounced falls on them and on the Earth. Various pains and penalties are now enacted.

The Creator, calling forth by name  
His mighty angels, gave them several  
charge,

As sorted best with present things

The first effect of these “Angelic Charges”  
that we notice, was to cause.

PAINFUL EXTREMES OF HEAT AND COLD.  
THE INEQUALITY OF THE SEASONS.

The Sun

Had first his precept so to move, so shine,  
As might affect the Earth with cold and heat  
Scarce tolerable, and from the north to call  
Decrepid winter, from the south to bring  
Solstitial summer’s heat.

(*Bk. 10, L., 651, etc.*)

The meaning of this passage is not clear. We can hardly imagine that Milton would fall into the error of thinking that cold comes from the north and heat from the south. Perhaps he had in mind only the northern hemisphere and the northern Solstice. To apply the language to the southern solstice the word would have to be reversed—winter from the south, summer from the north.

Some say he bid his angels turn askance  
 The poles of Earth twice ten degrees and  
     more  
 From the Sun's axle ; they with labour  
     pushed  
 Oblique the centric Globe : Some say the  
     Sun  
 Was bid turn reins from the equinoctial  
     road  
 Like distant breath—to Taurus with the  
     seven  
 Atlantic Sisters, and the Spartan Twins,  
 Up to the Tropic Crab ; thence down amain  
 By Leo, and the Virgin, and the Scales,  
 As deep as Capricorn ; to bring in change  
 Of seasons to each clime. Else had the  
     spring  
 Perpetual smiled on Earth with vernal  
     flowers  
 Equal in days and nights, except to those  
 Beyond the polar circles ; etc.

The poem assumes that originally the Earth  
was upright and that the tilting of its axis, causing  
the inequalities of the seasons, was one of the  
penalties incurred by the Fall. This tilting of  
 the axis is technically called "the Obliquity of  
 the Ecliptic," meaning, in plain words, that the  
 Earth is not upright. If it were, the planes of the  
 Ecliptic and the equator would coincide ; whereas  
 they make, at their intersection, an angle of  $23\frac{1}{2}$

degrees. This represents the extent of the inclination of our axis. Jupiter is almost upright, his figure is about 3 degrees. The inclination of Saturn, Mars, and probably Mercury is about the same as ours ; the figure of Venus and Uranus is 55, more than double what ours is ; that of Neptune is unknown.

The poem mentions two ways in which the change may have been effected. 1. By pushing askance the Earth's axis the required distance, or 2, By causing the Sun itself to deviate the required distance from his path, that is up to the Tropic of Cancer on one side, and down on the other side, as far as the Tropic of Capricorn, passing on the upward journey through Taurus (with the "seven Atlantic Sisters," that is, the Pleiades) and Gemini (the "Spartan Twins"), and, on the downward way, through Leo, Virgo, and Libra.

Note some of the results of our planet being upright. There would be no varying seasons ; all parts of the globe would have perpetual spring or autumn, except at the equator, where there would be perpetual summer. It is difficult to appreciate what effect this would have on vegetation. The temperature would decrease uniformly from the equator to the poles ; the days and nights would all be of equal length ; the sun would perpetually move round the unchanging equator, rising everywhere in the east and setting in the west.

It is strange that Milton should have imagined that the changing seasons constitute "a curse ;" we should rather call it "a blessing" !

Dr. Orchard, in his "Milton's Astronomy" says "The beautiful seasons, which impart such charm and variety to the rolling year, have in every age commanded the admiration of poets and of all lovers of nature who delight in the pleasing vicissitudes visible in Earth and sky that accompany each. Spring, with her verdant fields and flowery meads. Summer, decked in her pride of bloom and radiant sunshine. Autumn, rich with her gathered wealth of golden store ; and icy Winter, mantled in robe of snowy white, have each had their charms and attractive aspects portrayed by Milton in numbers that testify to their power of exciting his poetic fancy, and of stimulating the flow of his captivating muse."

A slight change is constantly in progress in the amount of the "obliquity." This was measured by Chinese astronomers 1,100 years B.C. For many Centuries past it has been slowly diminishing at the rate of about 48 seconds of arc per Century, or 1 degree in 7,500 years. At this rate the globe would be upright in about 177,000 years. But, as is so often the case, the movement is "pendulum-like." It is computed that in 15,000 years this diminishing movement will cease, and a movement of increase will begin. The

limits of variation are estimated at about  $2\frac{1}{2}$  degrees.

Another effect the poem assumes was caused by the Fall.

### THE MALEFIC EFFECTS OF THE PLANETS AND FIXED STARS.

To the blanc (pale or white) Moon  
Her office they prescribed ; to the other five  
Their planetary motions and aspects,  
In sextile, square, and trine, and opposite,  
Of noxious efficacy, and when to join  
In synod unbenign ; and taught the fixed  
Their influence when to shower—  
Which of them, rising with the Sun or  
falling,  
Should prove tempestuous.

According to the teachings of Astrology, if a planet, in one part of the zodiac, be distant from another by a sixth part of 12, that is by two signs, its aspect is called "sextile ;" if by a fourth, "square ;" if by a third, "trine ;" if by one half, "opposite." It is strange to think that Milton could thus identify himself with the belief of this pernicious pseudo-science, but the belief in it was general in his day.

In the story of the Creation a difficulty has always occurred to many minds from the fact that Light was created on the first day and the heavenly



bodies not till the fourth. According to Milton,  
Light, when first created, was

Spher'd in a radiant cloud, for yet the Sun  
Was not ; she in a cloudy tabernacle  
Sojourn'd the while.

*(Bk. 7, L., 247, etc.)*

and that on the fourth day, God created " lights " or luminaries, wherein were concentrated the mass of diffused light before existing. First the Sun was created, at first opaque and non-luminous.

For, of celestial bodies, first the Sun  
A mighty sphere he framed, unlightsome  
first,  
Though of ethereal mould ;

*(Bk. 7, L., 354, etc.)*

Then,

Of Light by far the greater part he took,  
Transplanted from her cloudy shrine, and  
placed  
In the Sun's orb, made porous to receive  
And drink the liquid light, firm to retain  
Her gathered beams, great palace now of  
Light.

The second of the heavenly bodies created  
was the Moon.

Less bright the Moon,  
But opposite in levelled west, was set,  
His mirror, with full face borrowing her  
light  
From him ; for other light she needed none



In that aspect, and still that distance keeps  
Till night ; then in the east her turn she  
shines

Revolved on heaven's great axle, and her  
reign

With thousand lesser lights dividual holds,

Then we come to the " Stars "—the millions  
upon millions of stars that modern astronomy has  
revealed to us. No more wonderful subject for  
contemplation exists than these innumerable orbs  
moving in space—a most intricate piece of celestial  
mechanism—held in their several orbits, in stable  
equilibrium, by their mutual attraction.

Mystical dance, which yonder starry sphere  
Of planets and of fixed in all her wheels  
Resembles nearest ; mazes intricate,  
Eccentric, intervolved, yet regular  
Then most when most irregular they seem :  
And in their motions harmony divine  
So smooths her charming tones that God's  
own ear  
Listens delighted.

(*Bk. 5, L., 620, etc.*)

In contrast with this beautiful and harmonious system of nature the complicated and blundering notions of the old astronomers are remarkable. What specially puzzled the ancients was how to account for the varying movements of the planets, which move, for a part of their course, in a direction contrary to that of the stars. Ingenious devices

were invented—most complicated systems of Cycles, Epicycles, Deferents, Eccentrics, etc.

The French Astronomer Flammarion says “ These cycles, epi-cycles, eccentricities, etc., were successively invented, modified and multiplied, according to the necessities of the case. As the observations became more precise it was necessary to add to their number in order to represent each new fact. Each Century added its new cycle, its new gear, to the mechanism of the universe ; so that at the time of Copernicus in the 16th Century they had some seventy-nine arrangements piled one upon another.” Of course, on the advent of the Copernican system, all this mass of learned rubbish was swept away.

Raphael talking to Adam, remarks with sarcasm

Or if they list to try  
Conjecture, he his fabric of the Heavens  
Hath left to their disputes—perhaps to  
move  
His laughter at their quaint opinions wide  
Hereafter, when they come to model  
Heaven,  
And calculate the stars ; how they will  
wield  
The mighty frame ; how build, unbuild,  
contrive  
To save appearances ; how gird the sphere

With Centric and Eccentric scribbled o'er,  
Cycle and Epicycle, Orb in Orb.

(*Bk. 8, L., 75, etc.*)

Milton's two allusions to Comets are well known :—

#### SATAN LIKENED TO A COMET.

On the other side,  
Incensed with indignation, Satan stood  
Unterrified, and like a comet burned,  
That fires the length of Ophiuchus huge  
In the arctic sky, and from his horrid hair  
Shakes pestilence and war.

(*Bk. 2, L., 706, etc.*)

Milton has another reference to a comet, further on in the same poem in which the sword of God is compared to a Comet.

High in front advanc'd  
The brandish'd sword of God before them  
blaz'd  
Fierce as a Comet : which with torrid heat,  
And vapours as the Libyan air adust,  
Began to parch that Temperate clime.

(*Bk. 12, L., 632.*)

#### URIEL'S RAPID FLIGHT FROM THE SUN LIKENED TO A SHOOTING STAR.

Thither came Uriel, gliding through the even  
On a sunbeam, swift as a shooting star  
In autumn thwarts the night,

(*Bk. 4, L., 555, etc.*)

MULCIBER'S FALL FROM HEAVEN  
LIKENED TO A FALLING STAR.

From morn  
To noon he fell, from noon to dewy eve,  
A summer's day, and with the setting sun  
Dropped from the zenith, like a falling star,  
On Lemnos, the Ægæan Isle.

*(Bk. 1, L, 742, etc.)*

These notes may fitly close with an extract  
from Adam and Eve's magnificent Morning Hymn.

Thou Sun, of this great world both eye and  
soul,

Acknowledge him thy greater ; sound his  
praise

In thy eternal course, both when thou  
climb'st,

And when high noon hast gained, and when  
thou fall'st.

Moon, that now meet'st the Orient Sun,  
now fliest,

With the fixed stars, fixed in their orb that  
flies ;

And ye five other wandering Fires, that  
move

In mystic dance, not without song, resound  
His praise who out of darkness called up  
Light.

*(Bk. 5, L., 171, etc.)*

## ASTRONOMY IN SOME OTHER POETS.

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One cannot wonder that the subjects with which Astronomy deals and the emotions kindled thereby should have appealed in all ages to the poetic faculty. Sublimity, vastness, beauty, calm, mystery, these are all materials for the poet and they are all inseparably connected with Astronomy.

We not infrequently hear it said that Science is hostile to Poetry. The writer emphatically dissents from this view. It is here maintained that Science inspires a poet and kindles Poetry, or, at all events, that it ought to. True, if a man busies himself exclusively with the "dry bones" of a science, with bare facts and naked observations and calculations, of course he will miss the largeness and the poetry of the matter. But if science be properly studied, with due regard to proportion, it must open the eyes, expand the mind, enlarge the outlook, give greater scope for the imagination, and all this is a stimulant, not an enemy to poetry.

These remarks are particularly applicable to the poetry of Tennyson. He is, essentially, the poet of modern astronomy. Chaucer, Spenser, Milton, all show more than ordinary knowledge of the science as understood in their day, but the great majority of the poets merely refer to the

more obvious astronomical phenomena and the metaphors suggested thereby, such as sunrise and sunset, sun, moon, stars, eclipses. Tennyson made a special study of the science and we get a far greater variety of astronomical allusions in his works than in any other poet. In fact, many of his allusions are quite unintelligible without some knowledge of the science.

In support of these remarks let me quote a few passages by Sir Norman Lockyer in his book "Tennyson as a Student and Poet of Nature." "It is right and fitting that the highest poetry should be associated with the highest knowledge. Tennyson's great achievement has been to show us that in the study of science we have one of the bases of the fullest poetry, a poetry which appeals at the same time to the deepest emotions and the highest and broadest intellects of mankind. Tennyson, in short, has shown that science and poetry, so far from being antagonistic, must for ever advance side by side. Tennyson was an enthusiastic astronomer and few points in the descriptive part of the subject escaped him. He was, therefore, often in the observatory. Some of his remarks still linger in my memory. One night when the moon's terminator swept across the broken ground round Tycho he said, "What a splendid Hell that would make." In his poems almost all natural phenomena are referred to in one place or another in language in which both



the truest poetry and most accurate science are blended."

Sir Norman Lockyer, after a visit he paid to the great poet two years before his death, said, "His mind is *saturated* with astronomy; since Dante there has never been so great a scientific poet."

TENNYSON. "THE HIGHER PANTHEISM."

The sun, the moon, the stars, the seas, the  
hills and the plains—  
Are not these, O Soul, the Vision of Him  
who reigns?

TENNYSON "PARNASSUS."

What are those crown'd forms high over  
the sacred fountain?  
Bards, that the mighty Muses have raised  
to the heights of the mountain  
Sounding for ever and ever thro' Earth and  
her listening nations,  
And mixt with the great Sphere-music of  
stars and of constellation.  
These are Astronomy and Geology, terrible  
Muses!

#### MORNING.

TENNYSON. "AKBAR'S DREAM."

And morn  
Has lifted the dark eyelash of the Night  
From off the rosy check of waking Day.



*Same Poem.*

Once again thou flamest heavenward, once  
again we see thee rise.

Every morning is thy birthday, gladdening  
human hearts and eyes.

Every morning here we greet it, bowing  
lowly down before thee,

Thee the Godlike, thee the changeless, in  
thine ever-changing skies.

TENNYSON. "MARIANA."

Till cold winds woke the gray-eyed morn.

TENNYSON. "THE PRINCESS."

Morn in the white wake of the morning star  
Came furrowing all the orient into gold.

SPENSER. "THE FAERY QUEENE."

At last, the golden Orientall gate  
Of highest heaven gan to open fayre ;  
And Phœbus, fresh as brydegrome to his  
mate.

Came dauncing forth, shaking his deawie  
hayre

And hurld his glistring beams through  
gloomy ayre.

*Same Poem.*

As fair Aurora in her purple pall  
Out of the East the dawning day doth call.

There are several other beautiful passages on  
"Sunrise" in "*The Faery Queene*."

MILTON. "PARADISE LOST."

Till morn,  
Waked by the circling hours with rosy hand,  
Unbarred the gates of light.

MILTON. "LYCIDAS."

So sinks the day-star in the ocean bed,  
And yet anon repairs his drooping head,  
And tricks his beams, and with new-  
spangled ore  
Flames in the forehead of the morning sky ;  
So Lycidas sunk low, but mounted high.

MILTON. "HYMN ON THE NATIVITY."

So, when the sun in bed,  
Curtained with cloudy red,  
Pillows his chin upon an orient wave,  
The flocking shadows pale  
Troop to the infernal jail, etc.

LONGFELLOW. "EVANGELINE."

Then there appeared and spread faint  
streaks of gray o'er her forehead,  
Dawn of another life that broke o'er her  
earthly horizon,  
As in the Eastern sky the first faint streaks  
of the morning.

#### EVENING.

TENNYSON. "THE FORESTERS."

The king of day hath stepped from off his  
throne,

Flung by the golden mantle of the cloud,  
And sets, a naked fire.

TENNYSON. "THE EAGLE. FRAGMENT."

Move eastward, happy earth, and leave  
Yon orange sunset waning slow ;  
From fringes of the faded eve,  
O, happy planet, eastward go ;  
Till over thy dark shoulder glow  
Thy silver sister-world, and rise  
To glass herself in dewy eyes  
That watch me from the glen below.

TENNYSON. "TO J.S."

His memory long will live alone  
In all our hearts, as mournful light  
That broods above the fallen sun,  
And dwells in heaven half the night.

SCOTT. "THE LADY OF THE LAKE."

The western waves of ebbing day  
Roll'd o'er the glen their level way ;  
Each purple peak, each flinty spire,  
Was bathed in floods of living fire.

KEBLE. "EVENING HYMN."

'Tis gone, that bright and orb'd blaze,  
Fast fading from our wistful gaze ;  
Yon mantling cloud has hid from sight  
The last faint pulse of quivering light.

NIGHT.

The night has a thousand eyes,  
And the day but one ;

Yet the light of the bright world dies  
With the dying sun.  
The mind has a thousand eyes,  
And the heart but one ;  
Yet the light of a whole life dies  
When love is done.

FRANCIS W. BOURDILLON.

### SUN AND MOON.

TENNYSON. "GARETH AND LYNETTE."

O Sun, that wakenest all to bliss or pain,  
O Moon, that layest all to sleep again,  
Shine sweetly :

TENNYSON. "TIRESIAS."

Fearing not to plunge  
Thy torch of life in darkness, rather thou  
Rejoicing that the sun, the moon, the stars  
Send no such light upon the ways of men  
As one great deed.

TENNYSON. "THE PRINCESS."

Great deeds cannot die ;  
They with the sun and moon renew their  
light  
For ever, blessing those that look on them.

### SUN-SPOTS.

Our knowledge regarding sun-spots is at present very imperfect. They are apparently cavities in the surface of the sun, filled with gases

or vapours of a lower temperature than the surrounding portions of the surface. The most common theory is that they are due to the down-rush of cooler gas from the upper regions of the solar atmosphere and a consequent welling up of heated materials from beneath. They are sometimes of enormous size, large enough to be seen by the naked eye if the sun's beams are tempered by mist or fog. They are not scattered all over the face of the sun, but are found, for the most part, only in a region a little above and a little below the sun's equator.

TENNYSON. "IN MEMORIAM."

And was the day of my delight  
As pure and perfect as I say ?  
The very source and fount of Day  
Is dash'd with wandering isles of night.

### THE MOON.

TENNYSON. "IN MEMORIAM."

And rise, O Moon, from yonder down,  
Till over down and over vale  
All night the shining vapour sail, etc.

TENNYSON. "THE RING."

Moon, you fade at times  
From the night,  
Young again you grow  
Out of sight.  
Silver crescent-curve

Coming soon,  
Globe again, and make  
Honey Moon.

TENNYSON. "THE PRINCESS."

Then, ere the silver sickle of that month  
Became her golden shield, I stole from  
court.

BURNS. "OPEN THE DOOR TO ME, OH !"

The wan moon is setting behind the white  
wave,

And time is setting with me. Oh !

At full moon, when the sun is setting in the  
west, the moon may be seen rising in the east ;  
thus both sun and moon may be seen together  
on opposite sides of the horizon.

TENNYSON. "THE LOTUS-EATERS."

They sat them down upon the yellow sand,  
Between the sun and moon upon the shore.

Lunar Halos are due to the fact that, on those  
evenings when halos are seen, there is a layer of  
light, feathery cloud, called "cirrus cloud,"  
high up in the atmosphere. This cloud is com-  
posed of myriads of tiny crystals of ice. The halo  
is caused by the refraction and reflection of light  
by these crystals.

TENNYSON. "MARGARET."

Like the tender amber round  
Which the moon about her spreadeth,  
Moving thro' a fleecy night.

## THE DEAD MOON.

TENNYSON. "LOCKSLEY HALL SIXTY YEARS  
AFTER."

Warless? War will die out late then.

Will it ever? Late or soon?

Can it, till this outworn earth be dead as  
yon dead world the moon?

Dead the new astronomy calls her . . .

. . . . .

Dead, but how her living glory lights the  
hall, the dune, the grass!

Yet the moonlight is the sunlight, and the  
sun himself will pass.

## MOON AND TIDES.

Tides are caused by the attraction of the Sun  
and Moon on the waters surrounding the earth.  
The moon, though by far the smaller body of the  
two, is so much nearer to us than the sun, that  
its attraction is a far greater force in causing tides.

TENNYSON. "THE PALACE OF ART."

that hears all night

The plunging seas draw backward from the  
land

Their moon-led waters white.

## MOON NEAR THE HORIZON.

It is frequently remarked that the Moon looks  
larger when low down in the sky than when at a  
high altitude. This is an optical illusion; for



when the moon is on the horizon it is in reality half the diameter of the earth, or 4,000 miles, further from us than it would be if it were in the zenith. Various explanations have been suggested of this phenomenon ; one is that distance appears greater if there are many intervening objects between us and the object viewed ; and that as the distance looks greater, the moon seems larger, and this is the case when the moon is low down, as we view it across a range of houses, hills, trees etc.

TENNYSON. " THE PALACE OF ART."

a tract of sand,  
And some one pacing there alone,  
Who paced for ever in a glimmering land,  
Lit with a low large moon.

### DOUBLE STARS.

Sir Norman Lockyer says, " Tennyson, although he was very shortsighted and wore spectacles, was never tired of observing and talking about the stars ; the double, or " married " stars, as the Poet once described them, had a special attraction for him."

Some stars which, to the naked eye, appear single, viewed through the telescope are found to be double, triple, quadruple, and multiple. True " double " stars or " binaries " are actually connected, revolving round each other ; they are

not mere “ optical ” doubles, appearing to be in close proximity. Some 12,000 double stars are known. As regards about 600 of these orbital motion has been ascertained. The following conspicuous stars are doubles,—Sirius, Capella, Procyon, Antares, Spica, the Pole Star, Algol, etc.

Mizar the middle star in the tail of the Great Bear, is double. The companion is also double. Alcor, the star apparently close by, is double, so that altogether there are six stars where the unaided eye can see but two, and the ordinary telescope three.

Epsilon Lyrae is a double star. To the naked eye it appears a faint single star ; in a small telescope or opera glass it appears double ; in large telescopes each star composing the double is seen to be itself double.

A remarkable feature of double stars is that they often shine with contrasted colours. The red star Antares has a green companion. In the pair Epsilon Bootis, the colours are orange and greenish blue. In Eta Cassiopeiæ they are yellow and purple. In Gamma Andromedæ yellow and green.

The French Astronomer Flammarion and others have indulged in some curious speculations as to what the effect would be on the denizens of planets (if such there be) lit by suns of differing colours. For example, take the case of a globe illumined by an orange and a blue sun. When

the planet was between the two suns, it would have an orange day (twelve hours), then, when the orange sun had set, the blue would rise, and so the orange day would be succeeded by a blue day of twelve hours and there would be no night.

TENNYSON. "TO PRINCESS BEATRICE."

But moving through the Mother's home,  
between

The two that love thee, lead a summer life,  
Sway'd by each Love, and swaying to each  
Love,

Like some conjectured planet in mid-heaven  
Between two suns, and drawing down from  
both

The light and genial warmth of double day.

TENNYSON. "THE PALACE OF ART." (in the  
first edition only).

Those double stars whereof the one more  
bright

Is circled by the other.

### DARK STARS.

Interesting and reliable evidence has been supplied in recent years of the existence of dark stars. Their existence cannot of course be proved by the evidence of sight, but by the effect they produce on the position of the spectral lines and on the light of other stars. They are known to be the cause of some "variable" stars, revolving

round these latter and, when they come between the star and us, cutting off a portion of its light. Some authorities have suggested that there are as many dark stars as light stars in the universe and that they are the main cause of stellar collisions, which latter are thought to be the cause of "new stars."

TENNYSON. "VASTNESS."

Many a hearth upon our dark globe sighs  
after many a vanish'd face,  
Many a planet by many a sun may roll with  
the dust of a vanish'd race.

TENNYSON. "DESPAIR."

And the homeless planet at length will be  
wheeled through the silence of space,  
Motherless evermore of an ever-vanishing  
race.

## VARIABLE STARS.

The existence of several "variable" stars is known. There may be many causes for this phenomenon, but one has been clearly proved and is referred to above in the note on "Dark Stars." Algol in Perseus is the chief of the variable stars. At intervals of about three days it drops from a second to nearly a fourth magnitude star; it remains constant for 20 minutes, and recovers its normal brightness in  $4\frac{1}{2}$  hours.

TENNYSON. "AYLMER'S FIELD."

Edith, whose pensive beauty, perfect else,  
But subject to the season or the mood,  
Shone like a mystic star between the less  
And greater glory varying to and fro,  
We know not wherefore ;

### THE POLE STAR.

TENNYSON. "THE PALACE OF ART."

A star that with the choral starry dance  
Join'd not, but stood, and standing saw  
The hollow orb of moving Circumstance  
Roll'd round by one fixed law.

Tennyson's own note on the above third line is "Some old writer calls the Heavens 'the Circumstance.'" ' When an undergraduate, a friend said to me, "'How fine the word 'circumstance' is, used in that sense.'" ' Here it is more or less a play on the word. The Ptolemaic astronomy describes the universe as scooped out of chaos."

SPENSER. "THE FAERY QUEENE."

By this the Northerne wagoner had set  
His sevenfold teme behind the stedfast  
starre  
That was in Ocean waves yet never wet,  
But firme is fixt.

## THE NEBULAR HYPOTHESIS.

“ A theory or supposition suggested by Kant, and then by Laplace, that the Solar System was formed by the cooling and contracting of a vast nebulous mass of globular form, rotating so swiftly that rings were thrown off, which consolidated into planets, and these, in their turn, rotated and threw off rings, which became satellites. In the light of modern discovery, however, the ring theory has given place to the view that the Solar System was evolved from one of the spiral nebulæ (the result of the collision of two bodies) and that instead of rings being thrown off from the original body consolidated portions were detached from the central mass, and, in the course of time, became planets and satellites.”

(“ *The A.B.C. Guide to Astronomy.*”)

TENNYSON. “ THE PRINCESS.”

This world was once a fluid haze of light,  
Till towards the centre set the starry tides,  
And eddied into suns, that wheeling cast  
The planets.

## EVOLUTION OF PLANETARY AND STELLAR SYSTEMS.

TENNYSON. “ GOD AND THE UNIVERSE.”

Must my day be dark by reason, O ye  
Heavens, of your boundless nights,  
Rush of Suns, and roll of systems, and  
your fiery clash of meteorites ?



TENNYSON. "THE PALACE OF ART." (in the  
first edition only).

Hither, when all the deep unsounded skies  
Shudder'd with silent stars, she clomb,  
And as with optic glasses her keen eyes  
Pierced through the mystic dome.  
Regions of lucid matter taking forms,  
Brushes of fire, hazy gleams,  
Clusters and beds of worlds, and bee-like  
swarms  
Of suns, and starry streams.

TENNYSON. "LUCRETIUS."

I saw the flaming atom-streams  
And torrents of her myriad universe,  
Ruining along the illimitable inane,  
Fly on to clash together again, and make  
Another and another frame of things  
For ever :

. . . . .

And therefore now  
Let her, that is the womb and tomb of all  
Great Nature, take, and forcing far apart  
Those blind beginnings that have made me  
man,  
Dash them anew together at her will  
Thro' all her cycles.

### THE MILKY WAY.

A broad luminous belt, composed of stars and  
nebulæ, encompassing the whole heavens.



TENNYSON. "EPILOGUE."

The fires that arch this dusky dot—  
Yon myriad-worlded way—  
The vast sun-clusters' gather'd blaze,  
World-isles in lonely skies,  
Whole heavens within ourselves, amaze  
Our brief humanities ;

TENNYSON. "THE LADY OF SHALOTT."

The gemmy bridle glittered free,  
Like to some branch of stars we see  
Hung in the golden Galaxy.

MILTON. "PARADISE LOST."

A broad and ample road whose dust is gold  
And pavement stars as stars to thee appear  
Seen in the Galaxy, that Milky Way  
Which nightly as a circling zone thou seest  
Powered with stars.

## VENUS.

The planet Venus is by far the most brilliant star in the sky. This is not by any means because of her size. She is but as a grain of sand compared with the distant "fixed stars," and, among the planets, a mere pigmy compared with Jupiter. She is rather smaller than our earth and is sometimes called our "sister planet." Her brightness is due to her nearness to us and to the sun. Venus has phases like the moon and these can be seen with a small telescope. It was thought by

some of the ancients that Venus was in reality two stars, Phosphorus the morning and Hesperus the evening star.

TENNYSON. "MAUD."

For a breeze of evening moves,  
And the planet of Love is on high,  
Beginning to faint in the light that she  
loves  
On a bed of daffodil sky,  
To faint in the light of the sun she loves,  
To faint in his light and to die.

TENNYSON. "IN MEMORIAM."

And last, returning from afar,  
Before the crimson-circled star  
Had fall'n into her father's grave.

MILTON. "PARADISE LOST."

Fairest of Stars, last in the train of Night,  
If better thou belong not to the Dawn.  
Sure pledge of day, that crown'st the smiling  
morn  
With thy bright circlet.

SHELLEY. "TO STELLA."

Thou wert the morning star among the  
living,  
Ere thy fair light had fled ;—  
Now, having died, thou art as Hesperus,  
giving  
New splendour to the dead.

TENNYSON. " IN MEMORIAM."

Sweet Hesper-Phosphor, double name  
For what is one, the first, the last,  
Thou, like my present and my past,  
Thy place is changed ; thou art the same.  
If we were in Venus or Mars we should see the  
Earth as a morning or evening star.

TENNYSON. " LOCKSLEY HALL SIXTY YEARS  
AFTER."

Venus near her ! (the moon) smiling down-  
ward at this earthlier earth of ours,  
Closer on the Sun, perhaps a world of never  
fading flowers.

. . . . .  
Hesper-Venus were we native to that  
splendour or in Mars,  
We should see the globe we groan in,  
fairest of their evening stars.  
Could we dream of wars and carnage, craft  
and madness, lust and spite,  
Roaring London, raving Paris, in that point  
of peaceful light ?  
Might we not in glancing heavenward on a  
star so silver-fair  
Yearn, and clasp the hands and murmur,  
' Would to God that we were there ' ?

#### MARS.

Mars differs from the other planets in this,  
that it presents many of the appearances of a

habitable globe, with conditions somewhat like ours. Much controversy has been raised with regard to the so-called "canals" of Mars. These cross the surface of the planet in all directions, running in straight lines, and frequently double. They are not permanent. They appear to form and disappear at different times of the year; and the remarkable point is, that contemporaneously with the melting and disappearance of the polar snow-caps, the canals make their appearance, while they disappear again as the snow-caps reform in the winter season. There appears to be no water on Mars, and it is probable that, owing to the extreme tenuity of the Martian atmosphere, little or no rain falls on its surface. Coupling this with the fact of the existence of the canals, it has been conjectured that the canals are artificial contrivances constructed by the inhabitants of Mars (if such there be) for the purposes of irrigation. In other words, that it is an ingenious device to supply the lack of water by utilizing the supply of snow which each winter brings and spreads over an extensive district of the polar regions.

It must, however, be understood that this theory is, in the present state of our knowledge, more or less in the nature of speculation and suggestion, and not by any means an established fact. Authorities are divided in opinion both as to the appearances and nature of the canals,

and very few hold that there is yet any sufficient ground for thinking that they exhibit anything like conclusive evidence of the handiwork of intelligent beings.

As regards the moons of Mars, here is an interesting story of our astronomer-poet.

TENNYSON. "THE PALACE OF ART."

She saw the snowy poles of moonless Mars.

This line appeared in the first edition of the poem in 1832. In 1877 Professor Asaph Hall, with the great Washington telescope, discovered that the planet had two little moons. Neither of them is reckoned to exceed 10 miles in diameter and they can only be seen by the largest telescopes. They have been named Deimos and Phobos. In consequence of this discovery the above line was altered in subsequent editions as follows, "She saw the snowy poles and moons of Mars." In the latest editions of the Poet's works the whole stanza has for some reason been omitted.

## SATURN.

TENNYSON. "THE PALACE OF ART."

And ' while the world runs round, ' I said,  
    ' Reign thou apart, a quiet king,  
Still as, while Saturn whirls, his stedfast  
    shade

    Sleeps on his luminous ring.'

Lord Tennyson, the poet's son's note to this

stanza is "The shadow of Saturn thrown on the luminous ring, though the planet revolves in ten and a half hours, appears to be motionless."

### NEPTUNE.

TENNYSON. "IN MEMORIAM."

When Science reaches forth her arms  
To feel from world to world, and charms  
Her secret from the latest moon.

The meaning of this stanza is not very clear. Sir Norman Lockyer says it refers to the discovery of Neptune in 1846. H. M. Percival, in his notes to "In Memoriam" says "the reference may be to the discovery of new satellites: namely, two of Uranus in 1847; that of Neptune in 1846; and one of Saturn in 1848.

### TWO MOTIONS OF THE PLANETS.

POPE. "ESSAY ON MAN."

On their own axis as the Planets run,  
Yet have at once their circle round the Sun;  
So two consistent motions act the Soul;  
And one regards Itself, and one the Whole.

### THE TWO MOST WIDELY SEPARATED PLANETS.

BROWNING. "PARACELSUS."

Let men  
Regard me, and the poet dead long ago  
Who loved too rashly; and shape forth a  
third

And better-tempered spirit, warned by  
both :

As from the over-radiant star too mad  
To drink the life-springs, beamless thence  
itself—

And the dark orb which borders the abyss,  
Engulphed in icy night—might have its  
course

A temperate and equidistant world.

Many readers of these lines will agree that, like many passages in the poet's works, they need elucidation. The meaning is this :—as from two men of opposite and extreme characters, a third and “ better-tempered spirit ” might be shaped forth, so from the nearest and the most distant planet from the sun a “ temperate ” world might be formed.

1. The first planet referred to is a conjectural planet supposed to lie between Mercury and the Sun, to which the name of “ Vulcan ” has sometimes been given. It is so eager to approach the Sun that it is to us “ beamless ” or invisible. (There is no reason to think that any such planet exists).

2. “ The dark orb,” etc., probably refers to Neptune (“ dark ” because invisible to our eyes) which is on the confines of our solar system and at such a distance from the Sun, its source of light and heat (2,000 million miles) that it may well be said to be “ engulfed in icy night.”



Or the poet may possibly have in his mind a conjectural planet still further away, which again, there is no reason to believe exists.

## MOVEMENT OF THE SOLAR SYSTEM IN SPACE.

One of the most wonderful discoveries of modern astronomy, which is now a well established fact, is that the sun and all the planets of our solar system are moving through space at an enormous speed, estimated at 40,000 miles an hour. The direction of the movement has been ascertained to be towards the constellation Lyra.

TENNYSON. "LOCKSLEY HALL SIXTY YEARS  
AFTER."

While the silent heavens roll and Suns along  
their fiery way,  
All their planets whirling round them, flash  
a million miles a day.

TENNYSON. "THE GOLDEN YEAR."

The Sun flies forward to his brother Sun ;  
The dark Earth follows wheel'd in her  
ellipse ;

## ECLIPSE.

TENNYSON. "IDYLLS OF THE KING.—

DEDICATION."

The shadow of His loss drew like eclipse,  
Darkening the world.

TENNYSON. "THE VISION OF SIN."

As when the sun, a crescent of eclipse,  
Dreams over lake and lawn, and isles and  
capes.

### COMETS.

Halley's Comet, which pays us a visit every 75 years, made its appearance in 1066. It is depicted on the celebrated Bayeux tapestry. It created universal dread throughout Europe and was looked upon as a presage of the Norman invasion.

TENNYSON. "HAROLD."

Lo! there once more—this is the seventh  
night

Yon grimly-glaring, treble-brandished  
scourge of England!

. . . . .

Look you, there's a star,

. . . . .

It glares in heaven, it flares upon the  
Thames,

The people are as thick as bees below,  
They hum like bees—they cannot speak—  
for awe.

. . . . .

Lord Leofwin, dost thou believe, that these  
Three rods of blood-red fire up yonder mean  
The doom of England and the wrath of  
Heaven?

## METEORS.

TENNYSON. "THE LADY OF SHALOTT."

As often thro' the purple night,  
Below the starry clusters bright,  
Some bearded meteor, trailing light,  
Moves over still Shalott.

TENNYSON. "THE PRINCESS."

Now slides the silent meteor on, and leaves  
A shining furrow, as thy thoughts in me.

## AURORA.

This remarkable and mysterious phenomenon is called by various names—Aurora Borealis, Northern Lights, Zodiacal Light. It is a band of faint pearly light, in the shape of a cone, stretching up from the sun after sunset at certain times of the year. We have no certain knowledge as to its origin. Some authorities believe it to be an extension of the sun's corona: others think its origin is to be found in meteoric dust. On the opposite of the heavens, and generally thought to be related to the zodiacal light, is an oval patch of light called "the Gegenschein" or "Counter glow," probably of meteoric origin.

TENNYSON. "LOCKSLEY HALL."

On her pallid cheek and forehead came a  
colour and a light,  
As I have seen the rosy red flushing in the  
northern night.

STARS.

BYRON. "CHILDE HAROLD."

Ye stars, which are the poetry of heaven !

If in your bright leaves we would learn the  
fate

Of men and empires—'tis to be forgiven,

That in our aspirations to be great,

Our destinies o'erleap their mortal state,

And claim a kindred with you, for ye are

A beauty and a mystery, and create

In us such love and reverence from afar,

That fortune, fame, power, life, have named  
themselves a star.

MATTHEW ARNOLD. "SELF-DEPENDENCE."

And a look of passionate desire

O'er the sea and to the stars I send ;

' Ye who from my childhood up have calmed  
me,

Calm me, ah, compose me to the end.

TENNYSON. "AYLMER'S FIELD."

Star to star vibrates light ; may soul to soul

Strike through a finer element of her own ?

So—from afar—touch as at once ?

To understand these lines reference should be made to the story. The love of Edith and Leolin is thwarted by Edith's parents. She dies ; and at the moment of her death a keen shriek uttered by Leolin was heard by the comrade of his chambers in the Temple, ' Yes love, yes,

Edith, yes.' The above lines open a wide subject much in vogue in many quarters to-day, when attention is given to Telepathy, Thought Transference, etc. There exists already, by rays of light, communication between us and the distant stars. Spectrum Analysis now enables us to know much about the chemical composition of these bodies, etc. The poet raises the pregnant question, as there is physical communication between star and star, may there not be means of communication between mind and mind, between soul and soul? A fine subject for the exercise of the scientific imagination! With what added force the words of Hamlet come to us, "There are more things in heaven and earth than are dreamt of in your philosophy."

### LIFE IN OTHER WORLDS.

TENNYSON. "DESPAIR."

And the suns of the limitless universe  
sparkled and shone in the sky,

. . . . .

The dark little worlds running round them  
were worlds of woe like our own.—

TENNYSON. "THE DUKE OF WELLINGTON."

Tho' world on world in myriad myriads roll  
Round us, each with different powers,  
And other forms of life than ours,  
What know we greater than the soul?

## STARS THAT NEVER SET.

There is a circle of stars round the pole star that never set ; they touch the northern horizon and then ascend again. In our latitude this circle is indicated roughly, on its opposite sides, by the two fine stars Vega and Capells. This circle of stars is never seen in the southern hemisphere. There is a corresponding circle round the south pole that *we* never see. The rest of the stars rise and set and are common to both hemispheres.

TENNYSON. "THE ANCIENT SAGE."

But earth's dark forehead flings athwart the  
    heavens  
Her shadow crown'd with stars—and  
    yonder—out  
To northward—some that never set, but  
    pass  
From sight and night to lose themselves in  
    day.

## SOUTHERN STARS APPEARING.

As travellers from northern latitudes go south, they see the southern stars gradually rising above the southern horizon.

TENNYSON. "THE VOYAGE."

New stars all night above the brim  
    Of waters lighten'd into view ;  
They climbed as quickly, for the rim  
    Changed every moment as we flew.

## THE GREAT BEAR.

TENNYSON. "THE PRINCESS."

Now pouring on the glow-worm, now the  
star,

I paced the terrace, till the Bear had  
wheel'd

Thro' a great arc his seven slow suns.

TENNYSON. "NEW YEAR'S EVE."

And we danced about the may-pole and in  
the hazel copse,

Till Charles's wain came out above the tall  
white chimney-tops.

## ORION AND THE PLEIADES.

TENNYSON.

Many a night from yonder ivied casement,  
ere I went to rest,

Did I look on great Orion, sloping slowly  
to the west.

Many a night I saw the Pleiades, rising  
thro' the mellow shade,

Glitter like a swarm of fire-flies tangled in  
a silver braid.

## PRECESSION OF THE EQUINOXES.

This phenomenon was discovered by Hip-  
parchus in B.C. 150. It is a slow advance from  
east to west of the equinoxes, that is of the point



of intersection of the celestial equator and the ecliptic. The yearly amount is very small, about 50 seconds of arc, or 20 minutes in time, but, in process of time, the amount is very palpable. It amounts to one degree in about 71 years, and the circle is completed in about 26,000 years.

Since the formation of the earliest catalogue of stars on record, the place of crossing of the equator and the ecliptic has retrograded about 30 degrees, or  $1/12$ th of the circle of the heavens. At the time of Hipparchus (2,000 years ago) the sun, at the vernal equinox, was in the sign Aries, it is now in Pisces, and all the other signs of the zodiac have shifted round in accordance with the movement. The movement in question is primarily due to the revolution of the pole of the earth round the pole of the ecliptic. This is a somewhat technical matter and cannot here be dealt with more fully.

SPENSER. "THE FAERY QUEENE."

Right now is wrong, and wrong that was is  
right ;

As all things else in time are chaunged  
quight ;

Ne wonder ; for the heavens revolution  
Is wandred farre from where it first was  
pight,

. . . . .

For whoso list into the heavens looke,

And search the courses of the rowling  
     spheares,  
 Shall find that from the point where they  
     first tooke  
 Their setting forth, in these few thousand  
     years  
 They all had wandered much ; that plaine  
     appeares,  
 For the same golden fleecy Ram  
     . . . . .  
 Hath now forgot where he was plast of  
     yore,  
     . . . . .  
 And eke the Bull hath with his bow-bent  
     horne  
 So hardly butted those two twinnes of  
     Jove,  
 That they have crusht the Crab, etc.

## ORION NEBULA.

This is the largest nebula yet known. It is one of the two that can be dimly seen with the naked eye, as a mist surrounding one of the stars in the "sword handle," which lies a short distance below the three conspicuous stars composing the "belt of Orion." The Astronomer Royal estimates that the brightest part of the nebula is ten million times the distance of the Sun from the earth, and that from one side to the other of

the nebula the distance is not less than ten billion miles.

TENNYSON. "MERLIN AND VIVIEN."

a single misty star,  
Which is the second in a line of stars  
That seem a sword beneath a belt of three,  
I never gazed upon it but I dreamt  
Of some vast charm concluded in that star  
To make fame nothing.

Lord Tennyson, the poet's son's note on these lines is—"My father often pondered on the nothingness of human fame by comparison with the charm of those immense spatial and temporal cosmic weavings and wavings."

### CALM OF INTERSTELLAR SPACE.

TENNYSON. "LUCRETIVS."

The Gods, who haunt  
The lucid interspace of world and world,  
Where never creeps a cloud, or moves a  
wind,  
Nor ever falls the least white star of snow,  
Nor ever lowest roll of thunder moane,  
Nor sound of human sorrow mounts to mar  
Their sacred everlasting calm !

In Young's "*Night Thoughts*" there are many references to astronomy.

Perhaps the best known passage of all is that in the 9th Night.

‘ Devotion : Daughter of Astronomy,  
An undevout Astronomer is mad,  
True, All Things speak a God ; but in the  
Small

Men trace him out ; in Great He seizes Man.  
Lord Byron in his “ *Prayer of Nature* ” says :  
“ Thou who canst guide the Wandering Star  
Through trackless realms of æther’s Space ;  
Who calm’st the Elemental War,  
Whose hand from Pole to Pole I trace.”

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